SEP 1 193

SEPTEMBER 1932—THIRTY-NINTH YEAR

MACHINERY

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THE JACOBS KEYLESS TYPE PORTOMATIC CHUCK

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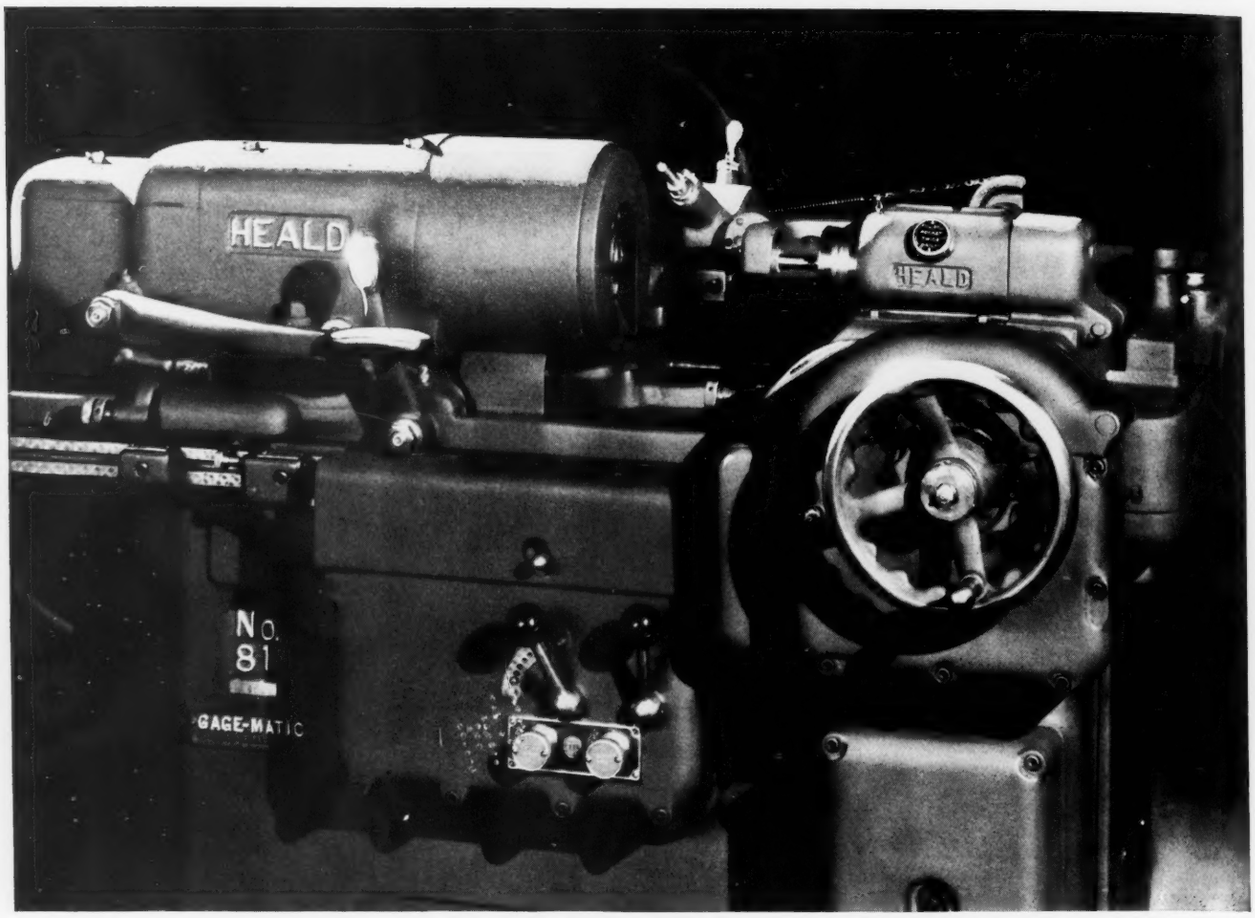

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HEALD

MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 39 SEPTEMBER, 1932 Number 1

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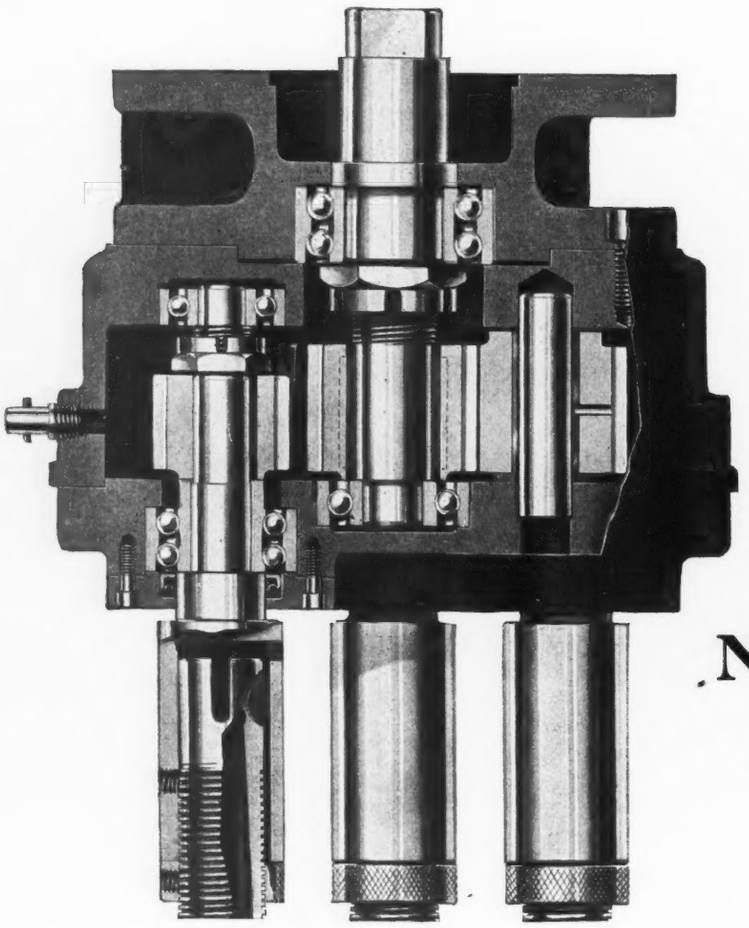

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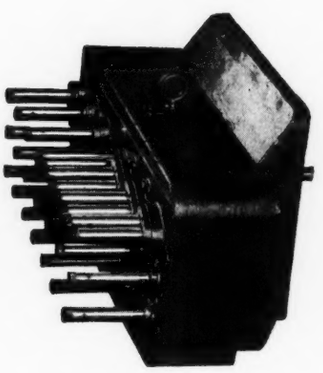
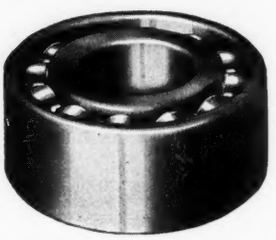


The main illustration shows a typical Snyder mounting. The New Departure Double Row is preloaded and makes a compact and rigid spindle unit.



• New Departure Ball Bearings •

MACHINERY

Volume 39 NEW YORK, SEPTEMBER, 1932 Number 1

Better Castings for Machine Construction

By HERBERT CHASE
Consulting Engineer
New York City

NICKEL-IRON alloys are being used extensively by many prominent machine tool builders for machine beds and a large variety of smaller parts. Nevertheless, there are still many engineers and production men who have not become fully acquainted with the advantages gained by adding even a small per cent of nickel to cast iron, and who will find the information given in the following outline of the results obtained by prominent machine tool builders of considerable value.

Foundries often increase the silicon content of ordinary gray-iron castings in order to eliminate hard spots that make the piece difficult or impossible to machine. If this is done in a casting having heavy sections, there is a tendency for these sections to become soft, open-grained, and porous, thus weakening the structure of the casting. The use of nickel in the mix makes it possible to keep the silicon content low and still avoid hard spots.

The average hardness is increased and wear resistance correspondingly improved by the addition of nickel. Although more power is required to machine a nickel-alloy casting, this is more than compensated for by the freedom from chilled spots which often dull the tool. Nickel eliminates the extremely hard iron carbides, and at the same time produces uniform hardness in sections of different thicknesses. Thus, nickel-iron castings with a hardness of around 240 Brinell machine as readily as plain gray iron with a hardness of 200 Brinell.

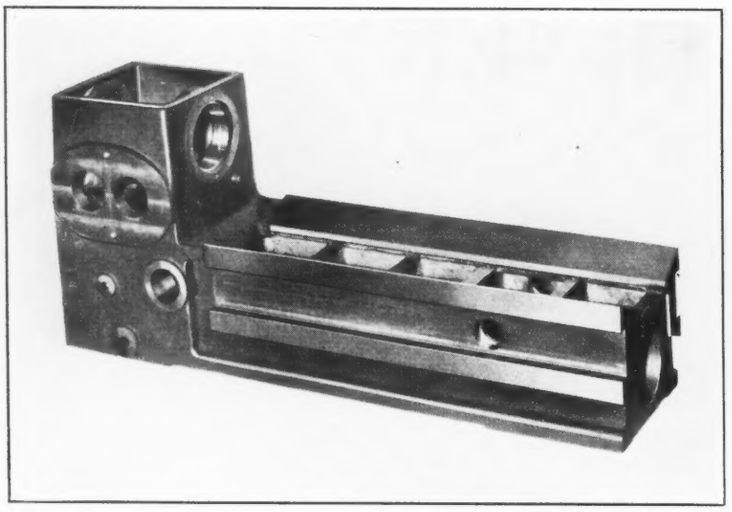
Larger, more accurate, and more intricate machines are constantly being developed. This development is more marked in some industries than in others; but, nevertheless, it is going on wherever machines are being built. Improved materials and manufacturing equipment have facilitated this development. The machine tool industry, which makes possible the construction of machinery of all kinds—from the simplest household appliance to a modern locomotive—is continually demanding or developing improved materials for use in the construction of machine tools. The experience of leading machine tool builders in the use of alloy castings as recorded here is, therefore, a valuable contribution to the entire machine-building field.

Castings containing no nickel are often so lacking in density that an open grain or void is found in the heavy sections. Frequently these faults do not appear until the casting has been machined to a considerable depth, as, for example, in cutting T-slots or V-shaped ways. Such a casting must be scrapped, which involves, besides the loss of the part, the additional loss incident to the machine work already accomplished. Even though porous spots may not be uncovered by the machining operations, they naturally decrease the strength and stiffness of the casting, so that it may fail when placed in service.

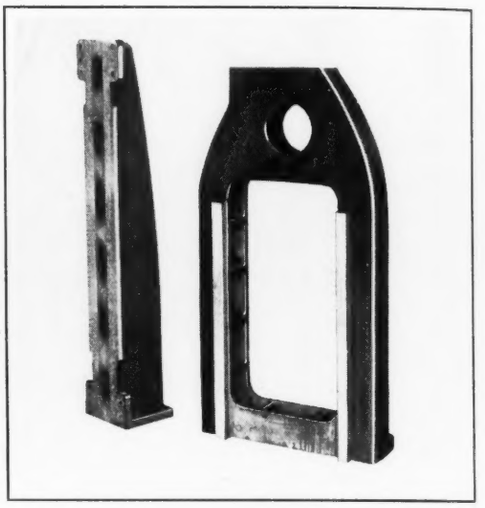
When rigidity is a factor of importance, as it usually is in machine tools, the use of nickel presents another advantage, for it disperses the free graphite and permits of lowering the total carbon to an extent not feasible in ordinary gray iron. In the latter material, the free carbon exists in relatively large flakes, which, so far as rigidity is concerned, may be considered as making so many voids in the matrix.

By reducing the total carbon and dispersing the free carbon into finely divided particles, the "voids" represent a smaller total volume and individually are much smaller. The net result is that Young's modulus is increased from between 12,000,000 and 15,000,000 for gray iron to between 18,000,000 and 24,000,000 for nickel iron.

Another important advantage gained by the use of nickel in cast iron is the improvement in surface



Lathe Bed and Headstock Casting Containing 1 Per Cent Nickel and 0.5 Per Cent Chromium



Hobbing Machine Parts Made from Nickel-iron Castings

finish. Even when an open-grained casting is strong enough, its appearance after machining may be such as to cause it to be rejected, with a consequent loss in finishing time, as well as in scrapped castings. Nickel, by assuring a dense structure, insures also a good surface finish, a stronger casting, and longer wear.

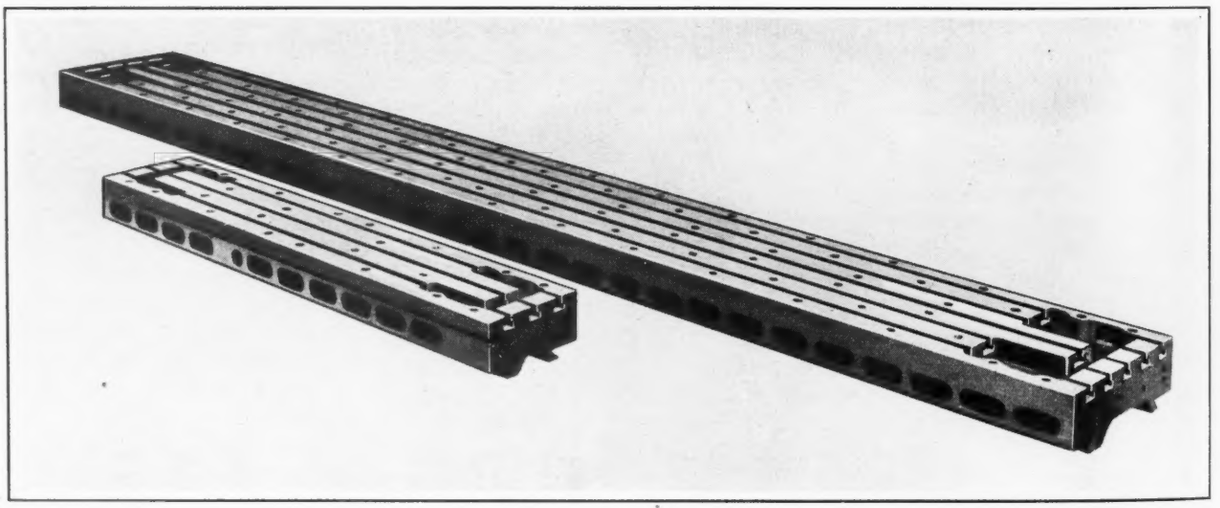
Small Per Cent of Nickel Produces Great Changes in Hardness and Strength of Castings

The addition of nickel, especially when accompanied by suitable changes in the base composition of the mix, increases the strength of the metal and thereby often enables the use of lighter sections, with a saving in the cost of the casting that may wholly or partly offset the increased cost of nickel iron, as compared with ordinary gray iron. Both the tensile and transverse strength of the metal can be increased 30 per cent or more in some cases by the addition of less than 2 per cent of nickel, and there is a corresponding increase in compressive strength without a sacrifice of toughness.

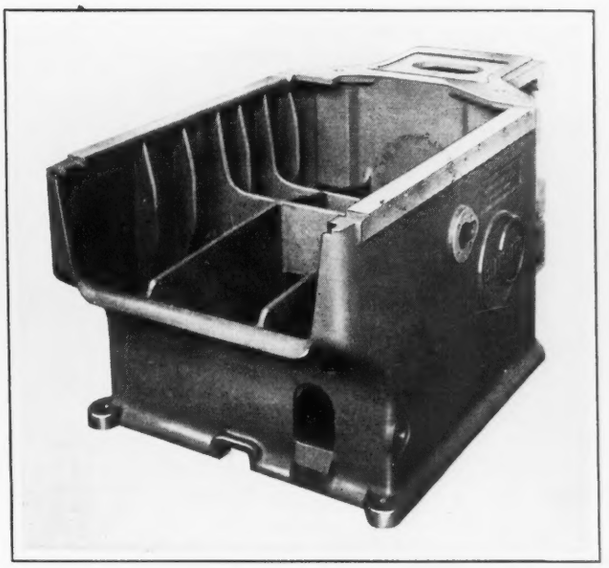
It is true, of course, that hardness in gray-iron castings can be produced on certain areas where high wear resistance is required by the use of chills. If the surface to be hardened is large, however, it is often necessary to employ a number of small chills. This results, in many cases, in open-grained metal between the chills and also in soft spots which make a surface that lacks uniformity in appearance, as well as in wear resistance.

The use of chills also increases the time required for making the mold and often multiplies the number of rejected castings, with a corresponding increase in the cost of accept-

Milling Machine Beds Cast from Mixture Containing 0.50 Per Cent Nickel and 1.10 to 1.30 Per Cent Silicon



Base for Vertical Surface Grinder Cast from Nickel Iron



able castings. Chills are not required when nickel iron is employed; and it is possible by the use of various nickel contents, in combination with changes in the percentage of silicon employed, to secure hardness values on the Brinell scale varying from about 160 up to 250, and at the same time to keep the machineability within the required limits.

In the accompanying table are given some of the analyses that are being used with success by different foundries producing nickel-iron machine tool castings. Such castings do not require annealing, but it is recommended that they be allowed to cool properly before they are removed from the molds.

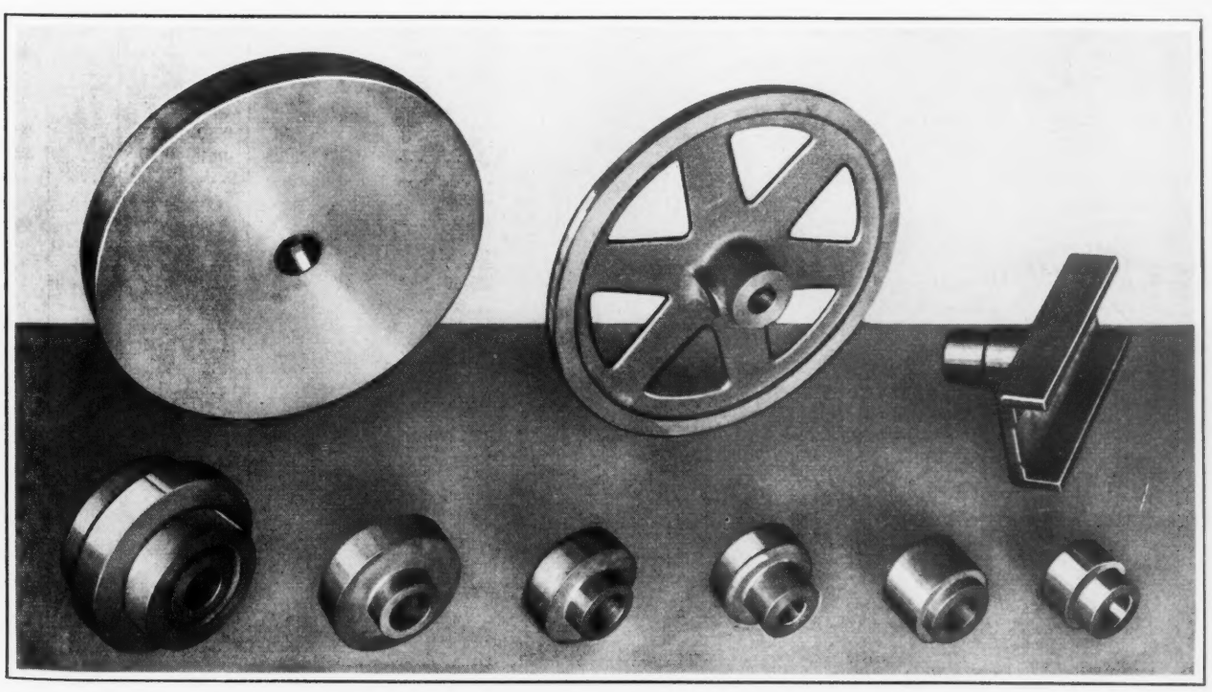
Producing Improved Castings for Shaper Parts

Turning now to specific experiences of machine tool manufacturers, that of a well-known maker of shapers may be considered. Chills had been employed on the ram and table in an effort to obtain a hard dense structure and to reduce the wear on the sliding surfaces. Difficulties had resulted from porous or open structure between the chills, and from defects arising from rusty or damp chills or from loose sand being washed away from the edges of the chills.

Some of these defects did not appear until after considerable machine work had been done; consequently, there was much loss, both in the machine shop and in the foundry, because of rejected castings. The foundry had found it necessary to pour an iron containing about 1.8 per cent silicon and not over 20 per cent steel scrap, in order to obtain the desired machineability. The foundry finally decided to try a mix containing 40 per cent steel scrap, 1.25 per cent silicon, and 1 per cent nickel, and to cast without chills. The resulting castings machined readily, and the appearance was so much improved that they could readily be identified in a lot containing both the nickel-iron and the gray-iron castings. The result is that this company is now specifying nickel iron for rams, tables, gears, and several other parts.

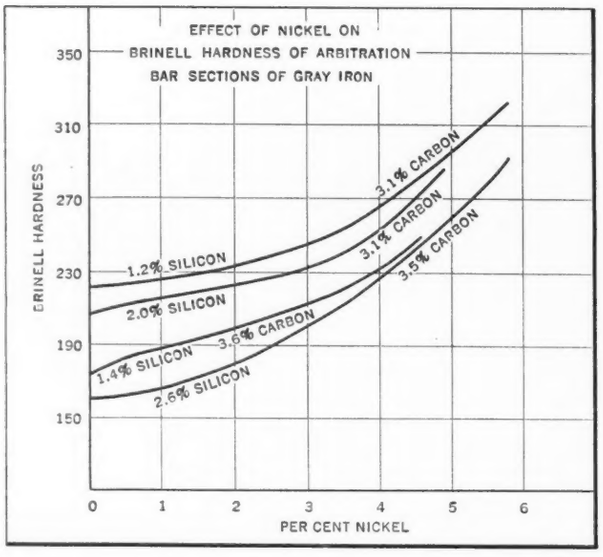
A large maker of lathes experienced difficulty in obtaining uniform density and hardness in the ways of his lathe beds, and also had trouble in preventing them from cracking. The bed, oil-pan, and gearcase formed an integral

Parts for Sawing Machine Cast from Iron with 2.5 to 3 Per Cent Nickel and 1 to 1.25 Per Cent Chromium



casting, with various sections measuring 1/2, 5/8, 3/4, 2 1/2, and 3 1/2 inches. To prevent cracking of the thin oil-pan and still obtain sufficient density of the ways, together with machineability on light sections, a duplex method of pouring was used.

A maximum of 8 per cent steel could be used in the mix for the ways. When the latter had been poured, a softer composition was run in at the other end of the mold to form the lighter sections of the casting. A change to a base composition containing 25 per cent steel, 37 1/2 per cent pig, and 37 1/2 per cent scrap, with 1.25 per cent silicon to which 1.5 per cent of nickel was added, made it possible to pour the whole mold from one composition. This also eliminated cracks, and gave uniform machineability and greater density and hardness to the ways.



Another prominent lathe manufacturer, who also produces a line of shapers, is specifying a base mixture containing 40 per cent steel, 30 per cent pig, and 30 per cent scrap, with a silicon content of 1.3 to 1.4 per cent, to which is added 1.25 per cent nickel and 0.30 per cent chromium. This is used for lathe beds and shaper castings, and gives a fine finish, with excellent wear-resisting properties.

At least one maker of gear-cutting machines is specifying 1 per cent of nickel for beds and other castings that present a wearing surface. The base mix, in this instance, contains 40 per cent steel, 30 per cent pig iron, and 30 per cent scrap, in which the carbon content is 3.3 per cent, silicon, 1.25 per cent, and manganese, 0.60 per cent.

A manufacturer who produces several sizes of lathes having beds varying in length from 4 to 20 feet is employing two different compositions, each of which contains 1.5 per cent of nickel. A half inch of metal is machined from part of the ways, and this necessitates a close-grained iron at the core. On the smaller beds, a base mix containing

Typical Applications of Alloy Iron Castings in the Machine Tool Industry

Name of Product	Name of Part	Alloy, Per Cent		Approximate Base Composition, Per Cent								
		Nickel	Chromium	Steel	Pig Iron	Scrap	Silvery Pig	Silicon	Manganese	Phosphorus	Sulphur	Total Carbon
Lathes	Beds	1.00	0.25	30–35	.....	...	...	...	...	...	...	...
Lathes	Beds	1.00	...	40	30	30	...	1.10	0.60	0.30	0.08	...
Lathes	Beds, Small	1.00	...	25–30	30–40	bal.	...	1.50	0.60	0.30	...	...
Lathes	Beds, Large	1.00	...	35–40	30–40	bal.	...	1.10	0.70	low	0.08	...
Milling Machines	Base, Beds, Tables	0.75–1.00	...	30	40	30	...	1.30	0.60	low	...	...
Lathe	Beds	1.00	...	80	.....	...	20	1.70	...	...	...	2.85
Lathes, Engine	Beds	1.00	0.25	30–35	.....	...	...	...	...	...	...	...
Planers	Beds, Tables, Heads, etc.	0.75–0.50	...	40–60	.....	...	...	...	...	...	...	...
Boring Mills	Columns, Over-arms Spindles, Tables, Rams	1.00	...	80	.....	...	20	1.80	0.80	0.15	...	2.90
Lathes	Beds	1.00	...	80	.....	...	20	2.80	0.80	0.15	...	2.90
Lathes	Beds	1.00	...	30–35	.....	...	...	...	...	...	...	...
Lathes	Beds	1.00	...	50–70	.....	...	...	...	...	...	...	...
Lathes	Beds	1.00	...	35–45	.....	...	...	...	...	...	...	...
Lathes, Shapers, Drilling Machines	.....	1.00	...	70	.....	...	15*	...	...	...	...	...
Lathes	Beds, Carriages	1.00	...	30–40	30–40	bal.	..	...	...	...	...	...
Drill Press	Base, Table, Gears	0.75–1.00	0.25	.....	.....	...	...	...	...	...	...	...
Lathes	Beds, Turrets	1.00	...	80	.....	...	20	...	...	...	...	...
Milling Machine	Beds	1.00	...	30–50	.....	...	...	...	...	...	...	...
Boring Mills	Platens, Columns	0.75–1.00	...	30–50	.....	...	...	...	...	...	...	...
Boring Mills	Platens, Columns	1.00	...	30–40	.....	...	...	...	...	...	...	...
Gear Cutters	Bases, Bushings	1.00	...	30–40	.....	...	...	...	...	...	...	...
Hobbing Machines	All Parts Subject to Wear, Beds, Slides, etc.	1.00	...	40	30	30	...	1.25	0.60	...	...	3.30
Sawing Machines	Gears, Pinions, Cross-heads	2.50–3.00	1.00–1.25	30	.....	...	...	1.50	...	...	...	...
Gear Shapers	Nearly All Parts	1.00–1.50	...	.....	.....	...	...	...	...	...	...	...
Shapers	Rams, Table, Gears, etc.	1.00	...	40	.....	...	...	1.25	...	...	...	...
Lathes and Shapers	Beds and All Parts Subject to Wear	1.00–2.00	...	40	30	30	...	1.35	...	...	...	...
Presses	Toggles, Cams, Gears	1.50	...	.....	.....	...	...	...	...	...	...	...
Lathe	90-inch Faceplate Gear	1.75–2.00	...	70	.....	...	...	0.85	0.85	0.12	0.12	2.95

*The remaining 14 per cent is made up of rejected castings.

50 per cent steel, 20 per cent high-silicon pig, and 30 per cent returns or rejected castings is employed. These castings show 3 per cent carbon, 1.5 per cent silicon, and 0.8 per cent manganese.

For the larger beds, the base mix is 75 per cent steel and 25 per cent high-silicon pig, showing 2.8 per cent carbon, 1.4 per cent silicon, and 0.8 per cent manganese. These mixtures (both containing 1.5 per cent nickel) give the desired grain structure and the machineability required.

Composition of Casting Used for Gears

Gears and other parts of one make of sawing machine that are subjected to severe wear are being cast from a die iron containing 30 per cent steel, 1.5 per cent silicon, 2.5 per cent nickel, and 1 per cent chromium. The chromium, when used in addition to nickel, adds to the hardness and to the wear resistance, but is not required in the majority of machine tool applications unless exceptional wear resistance is essential.

As will be seen from the foregoing examples, various foundries vary the base mix considerably and the nickel content to some extent. In the average case, a nickel content of about 1 per cent appears to be giving the desired results; but when greater hardness and wear resistance are desired without sacrificing machineability, the nickel content is increased up to 2.5 per cent or more, and occasionally some chromium is added.

While it is true that the use of nickel often results in a somewhat higher cost for the unfinished casting, the savings in machine work and in the cost of castings rejected for flaws that do not show up until the machining has been done are believed to more than offset the higher cost of the alloy casting, in most cases. The gain includes better appearance, increased wear resistance, and greater stiffness of the finished casting. In some instances, the greater strength of the nickel iron will permit the weight of the casting to be decreased sufficiently to offset the added cost of the alloying element.

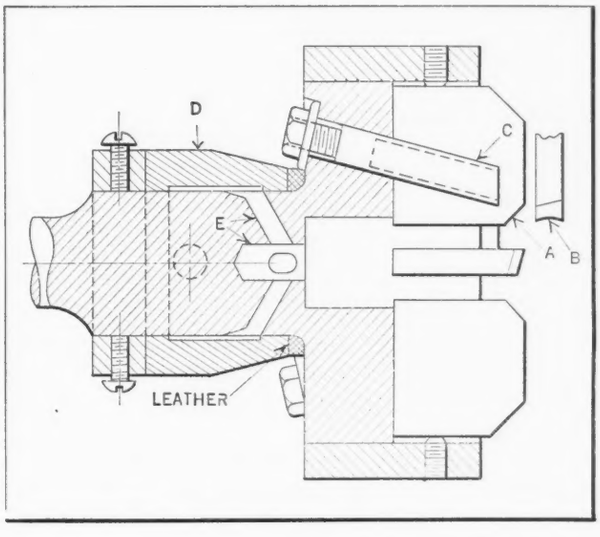
Hollow-Mill with Cutters that Burnish as Well as Turn the Work

By F. E. WERTHEIM

Most agricultural implement shops have certain types of studs or shaft projections to machine that can best be handled by hollow-milling. With the demand for interchangeability, an effort was made in one such plant to produce hollow-mills that would do accurate work and still be suitable for high production. As a result, mills of the design illustrated were made, ranging in size from 1 inch to 1 15/16 inches. All the cutting is done by the narrow leading edge *A* of the cutters, the heel *B* being formed to burnish the work after it is turned.

The cutters are clamped in position by the wedge bolts *C;* incidentally, the curved burnishing surfaces *B* are ground to the correct diameter in the position indicated by means of a small internal grinding wheel. Provision is made for supplying coolant to the cutting edges through the stationary sleeve *D* and the holes *E* drilled in the holder. The supply pipe is connected to the sleeve, so that the coolant flows steadily upon the cutters.

The idea underlying this design was used in other much simpler hollow-mills having no provision for a coolant. The cutters in this case were held by set-screws instead of wedge clamps. Although the cost of these tools was much less, their performance was equally satisfactory.



Hollow-mill in which the Heel of Each Cutter is Formed to Burnish the Work

* * *

Railroad freight shipments resulting from the manufacture and use of automobiles are making a better comparative showing during the present period than other manufactured goods. In 1929, automobile and parts shipments accounted for 23 per cent of the shipments of all articles classified by the Interstate Commerce Commission as "Manufactures" and "Miscellaneous." In 1930, they represented 24 per cent, and in 1931, nearly 29 per cent. The shipment of materials for highway building, which are classified by the commission as "Products of Forests and Mines," in 1931 accounted for 7.6 per cent of railroad shipments in this group, as against 4.5 per cent in 1929.

Why Machines are Damaged in Shipment

Better Blocking and Better Crating Would Greatly Reduce the Damage to Machinery Shipped by Rail

By JOHN G. DAVIES

ONE finds, even among shippers of long experience, a surprising lack of knowledge concerning adequate methods of protecting machinery while in transit in a railroad car. Machinery, especially of the heavier type, is frequently damaged in transit. In addition to the physical damage, a sale may be lost, pending repairs, or an order may be cancelled. The amounts involved in claims for compensation are usually large, the courts may be invoked, and there may be a long delay in the final settlement.

Fully 60 per cent of the damage done to carload shipments of machinery could be avoided if the shippers availed themselves of a service that every railroad extends. That service consists of furnishing the shipper with the assistance of a loading expert, who, without cost, will supervise the loading and bracing of a car. This representative is thoroughly familiar with loading requirements; but although this service is at the disposal of shippers, few take advantage of it.

Following the claim for heavy compensation on a shipment, the railroads often send, of their own volition, a representative to protect their interests while loading another car with similar machinery. This service is often not accepted in the spirit in which it is offered. The manager of the concern making the shipment senses, in the appearance of the inspector, a criticism of his own ability to supervise the loading. This is a wrong attitude. The loading expert, while supervising the loading of a car, is, in reality, an employe of the firm whose shipment he is inspecting. He is working for the shipper's interests, while aiming to reduce possible damage claims against the railroad.

If the officials of large corporations would seek the assistance of the railroads in instructing their shipping departments, fewer damage claims would result and the shipper would gain greater business prestige.

The two principal causes of damage are unsatisfactory bracing, blocking, or crating; and the use of inferior lumber, or lumber of insufficient strength. Present rigid economy programs have increased the chances of damage tremendously. Nevertheless to attempt to save money at the expense of neglecting to provide the proper protection for a shipment is a case of being penny-wise and pound foolish. The losses due to damaged shipments far outweigh the increased cost of lumber for proper blocking or crating. Wise shippers do not try to economize in this direction.

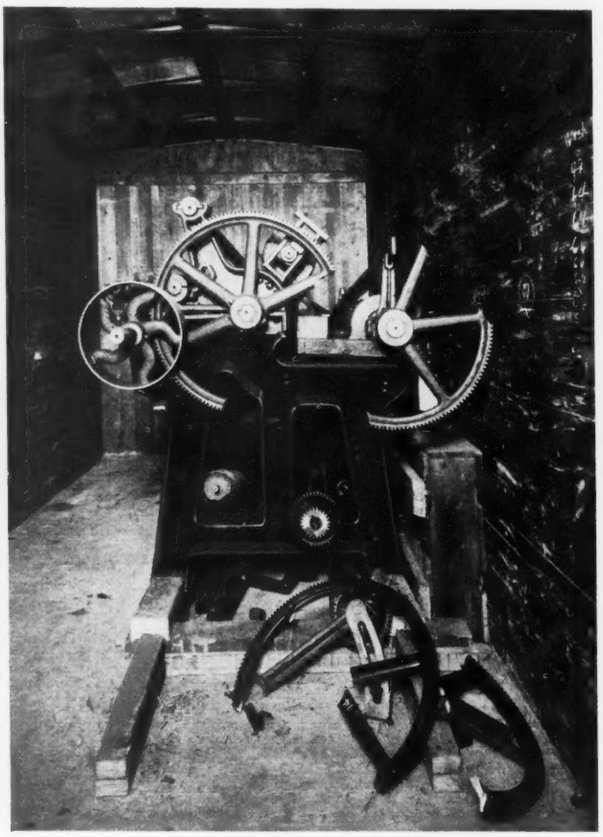


Fig. 1. Gearing Completely Broken by Two Machines Being Blocked too Close Together for Shipment

Fig. 1 shows the condition of a heavy paper-coating machine at the end of a transcontinental haul. This damage is due to the fact that sufficient shifting space was not allowed, and that the machine was loaded adjacent to a similar machine having extending gears. Also, sufficient wall clearance was not allowed.

The machine was skidded and bolted, and, as illustrated, had three widths of 2- by 4-inch lumber as blocking, nailed to both the skids and the car floor. The mistake in blocking this machine was in failure to allow for shifting. The blocking is intact and that fact is partly responsible for the breakage.

There is no fault with the thoroughness of the blocking. However, machines weighing several tons should be blocked to allow for a "governed shifting space." This machine should have been allowed about 1 1/2 to 2 inches of shifting space between the ends of the skids and the face of the blocking. One might think that this would allow the skids to tear the blocking from the car floor, but that does

not happen. The adjacent machine should, of course, have been placed far enough away to prevent damage from the two machines colliding.

Machines that are top-heavy are very susceptible to damage. In Fig. 1, if the shipper preferred to block the base so thoroughly, he should also have counterbraced the top or heavy part of the machine. This would have distributed the strain equally. Shocks sustained by the car caused the heavy part of the machine to throw its weight forward against the unyielding base blocking, with the result that the machine threw itself out of horizontal alignment and came into contact with the machine next

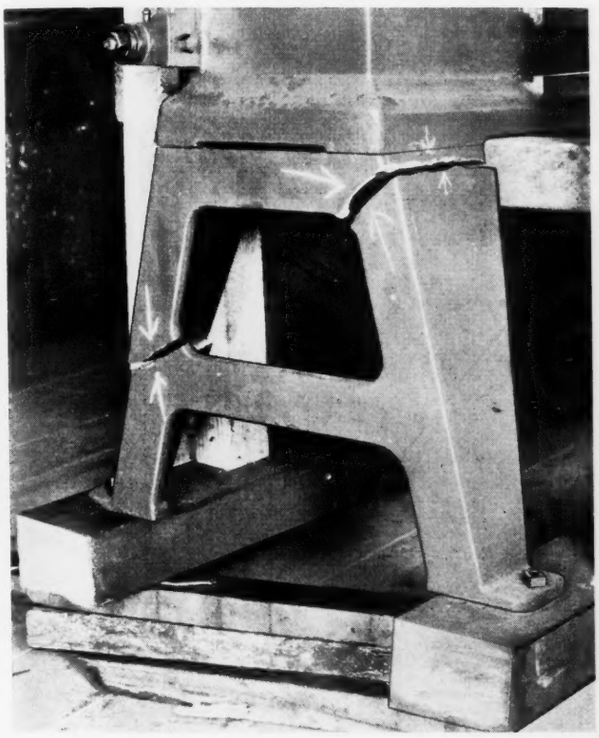


Fig. 2. A Heavy Lathe Badly Damaged Because of Incorrect Bracing and too Rigid Blocking

to it. If two 4- by 4-inch braces had been placed from the end of the floor blocking to the upper part of the machine, at both ends, this could have been prevented.

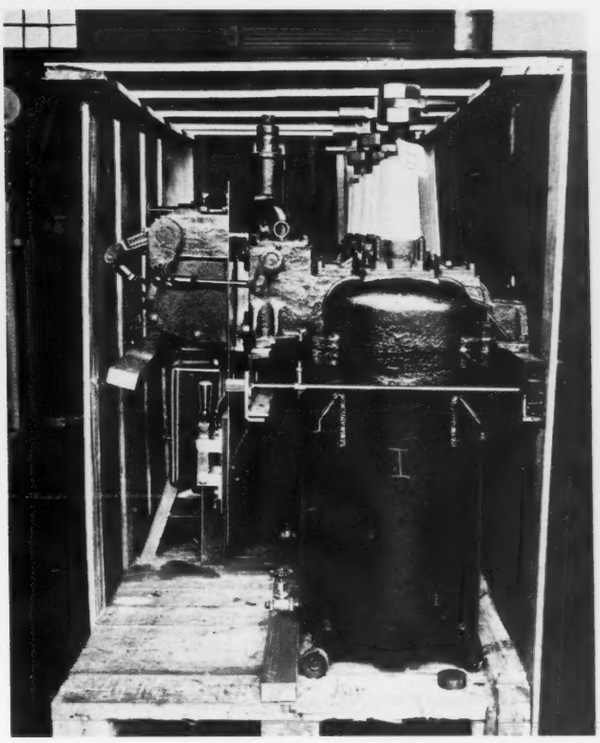
What is Meant by "Governed Shifting Space"

When the runners of the skids are blocked on the side to prevent the machine from working to either side, the shocks may be taken up by allowing a shifting space between the ends of the skids and the floor blocking. It will take an extraordinary shock to shift a heavy machine such as illustrated. Therefore, each shock, no matter from which end it is received, is absorbed in the shifting space; and no shock, except a wreck, would shift the machine sufficiently to dislodge the floor blocking. If the machine is to be rigidly blocked, it must be braced with 4- by 4-inch lumber against each end.

Damage to Heavy Lathe Due to Incorrect Bracing

Fig. 2 shows the base of a heavy lathe completely broken in two. The upper part of the casting had been thrown forward fully one inch before the break occurred. This clearly indicates the tremendous force exerted by the heavy upper portion being thrown forward. The two 4- by 4-inch uprights that are nailed to a similar-sized cross-piece under the bed were largely responsible for the damage. They provided a pivot for the heavy bed when it was thrown forward over the rigidly fixed base casting. Had these two uprights been placed against

Fig. 3. An Example of Insufficient Crating Provided for a Heavy Piece of Machinery



the end of the head of the machine and braced to the car floor, they would have prevented the forward thrust of the upper part of the lathe.

There are no set rules for the loading and bracing of machinery. The blocking and crating depend upon the type of machine, its weight, and size. However, had the shipper in the cases mentioned called in a railroad inspector, the damage would have been prevented. The inspector would have advised on blocking and bracing that would have prevented the mistakes which resulted in the damage.

In Fig. 3 is shown a heavy piece of power plant equipment. Note how inadequate the crating is. The base is of sufficient strength; but the sides

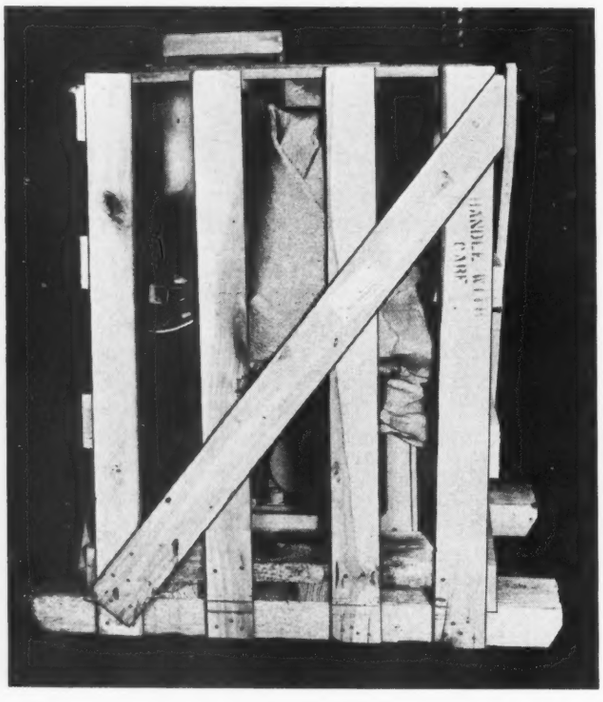
and top, made from 1- by 4-inch slats, are totally inadequate to withstand possible side swing of the machine while in transit.

To begin with, machines of this type should preferably be loaded lengthwise of the car rather than sidewise. On machines placed on wheels or rollers, provided the wheels are 8 inches or less in height, it is preferable to load them crosswise of the car, so that a forward movement does not have the benefit of the wheels in case the machine becomes loose in the crate.

In Fig. 3, the side swing of the machine pulled the 2- by 4-inch cross-piece straight out from the 1- by 4-inch side slats, allowing the machine ungoverned side-swing. A machine of this type should have been crated with 2- by 4-inch slats on a 4- by 4-inch or 6- by 6-inch skid and floor.

Fig. 4 shows an excellent example of crated machinery. The base skids are 4- by 4-inch, held together by 2- by 4-inch slats which act as a floor for the base casting of the machine. After the machine has been placed on the skid floor, the precaution has been taken of blocking the machine inside the crate as well as of wrapping it. The outer structure of 1- by 4-inch slats is, in this case, further strengthened by a diagonal brace providing ample protection against accidental damage.

Fig. 4. An Example of a Machine that is Properly Crated for Shipment



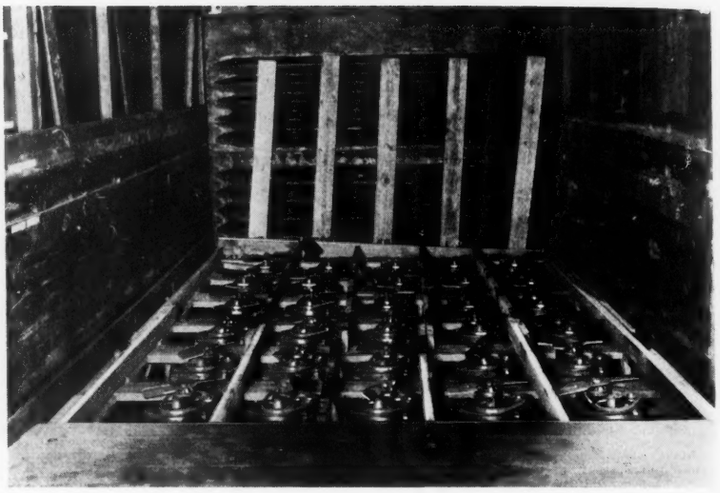


Fig. 5. An Excellent Job of Crating by Means of Well Placed Blocking

Fig. 5 may be termed a perfect job of crating by means of well placed blocking. Each engine is compactly fitted into a separate compartment. The 2- by 4-inch bracing is repeated at intervals from the top of the engine to the floor of the car, and is so placed that no attachments on the side of the engine will be dislodged. There is no chance for shifting, and the wall clearance is taken up with double 2- by 4-inch lumber. The doorway is protected by a solid bulkhead of 2- by 6-inch planks.

* * *

New Fractional Horsepower Motors

Manufacturers throughout the country are getting new lines of machinery ready in anticipation of an early return of industrial activity. The Westinghouse Electric & Mfg. Co. has just announced the development of a complete new line of fractional horsepower motors. An unusual degree of interchangeability has been achieved in these new designs. Five frame sizes suffice to serve the entire line, ranging in output from 1/30 to 3/4 horsepower. Formerly, more than one hundred frame sizes were required. All types of small motors are affected by the new designs. A feature of the new motors is an improved type of resilient spring mounting.

* * *

Power and Mechanical Engineering Exposition

The Tenth National Exposition of Power and Mechanical Engineering will be held at Grand Central Palace, New York City, December 5–10. Two years have elapsed since the last big exposition of power and mechanical engineering equipment, and in the meantime many new developments have taken place in this branch of industry. Over three hundred firms will exhibit.

Air Nozzles for Ejecting Scrap from Dies

By EDWARD LAY

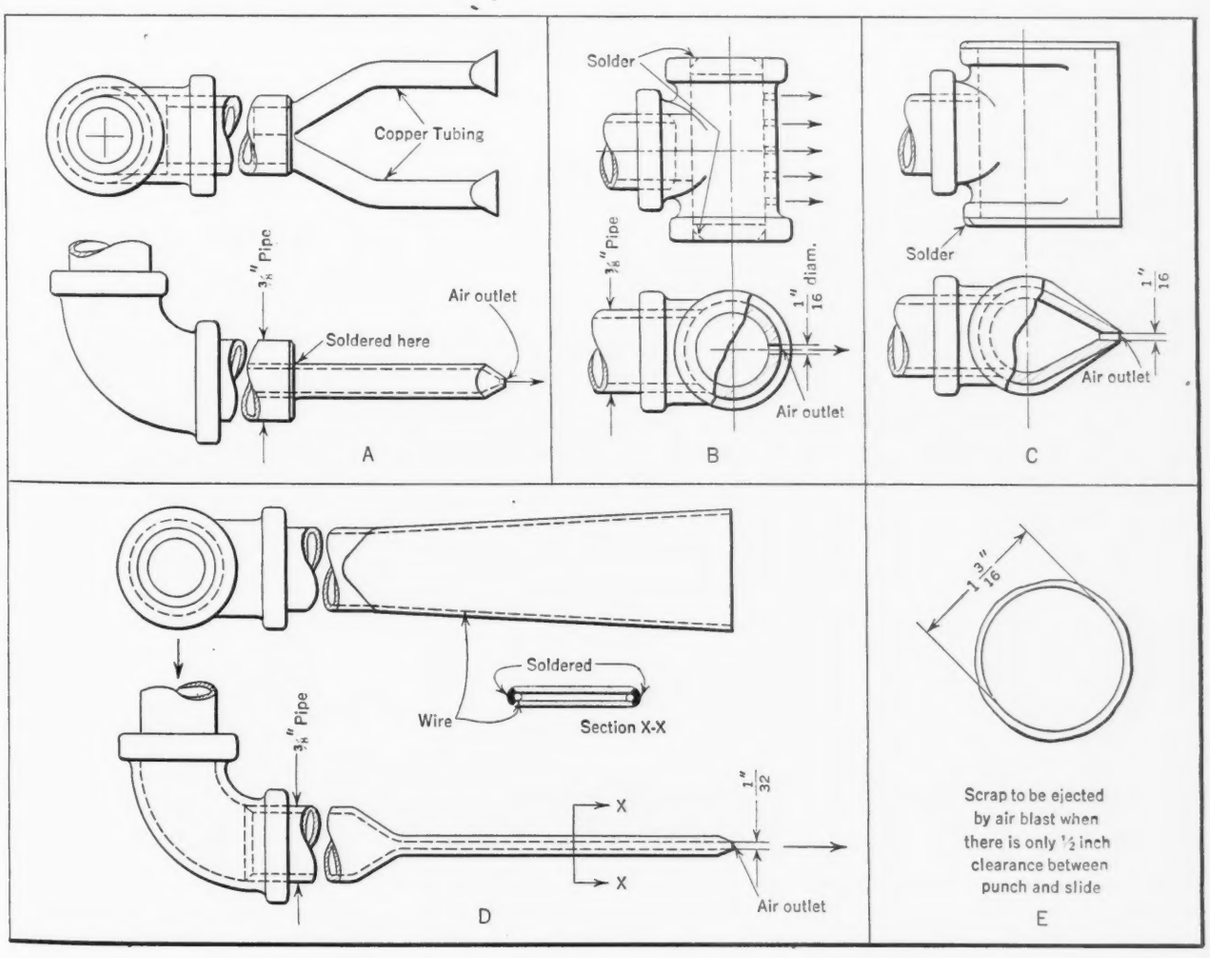
Metal trimmings, such as shown at *E* in the accompanying illustration, were required to be ejected from a transfer die after the intermediate trimming operation, in order to prevent interference with succeeding operations. The compressed air lines used for ejecting scrap pieces were equipped with various types of nozzles, three of which are shown at *A*, *B*, and *C*.

With the air valves all opened wide, trouble was experienced because the scrap often dropped down on the dies. This prevented the transfer slides from operating properly and shortened the life of the trimming die and the punch. When the pressure in the air line was low, some of the presses had to be stopped, and, as a result, the scheduled production was never obtained.

To remedy these troubles, a more efficient air nozzle was designed, which not only directed the air more effectively against the scrap, but also reduced the amount of air used. The improved nozzle shown at *D* was inexpensive to construct, being made from 3/8-inch black iron pipe, threaded and countersunk at one end to fit the air-line fittings. The other end of the pipe was slit with a hacksaw for a length of about 4 inches and heated up to a red heat for forging to the shape shown.

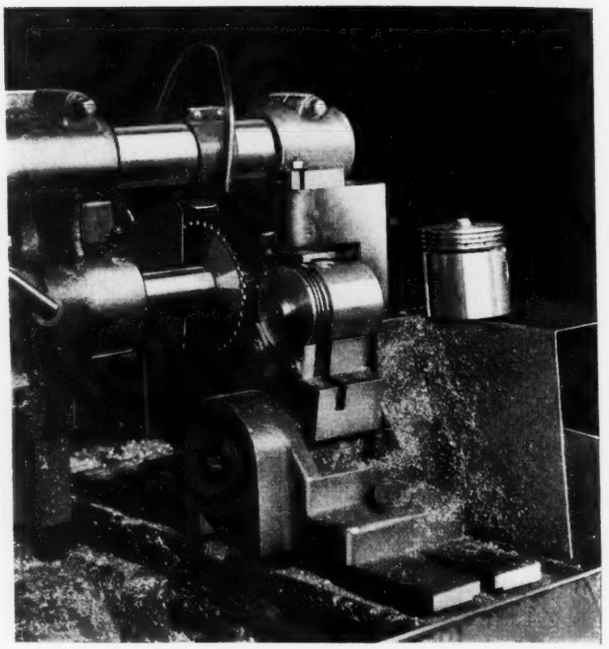
Just before performing the forging operation, a flat piece of sheet steel, 0.030 inch thick, was placed in the slot. This piece of sheet metal served to gage the size of the opening and to produce a smooth inner surface. After the forging operation, the sheet metal was removed and a wire slightly larger in diameter than the width of the slot was then pressed into each of the open sides of the flattened portion. The sides were then sealed by soldering, the wire giving the inside of the nozzle a smooth finish and preventing the solder from running into the slot.

After properly attaching and adjusting this nozzle to the air line, no further trouble was experienced in ejecting the scrap. All the presses with which trouble had been encountered were then equipped with the new air nozzle. As a result, production was kept up to schedule and the life of the press tools was lengthened. Also, there was a great reduction in the amount of compressed air used, and the noise of escaping air was reduced so that it could not be heard when the presses were in operation.



Views A, B, and C Show Air Nozzles Unsatisfactory for Ejecting the Scrap E. View D Shows the Improved Nozzle

New Piston Material Cut by Carbide Tools



BEGINNING with the 1932 models, the automobiles built by the Hudson Motor Car Co. have been equipped with pistons made from Lo-Ex or Alcoa 132 aluminum alloy. Pistons of this metal were adopted because the alloy has a coefficient of thermal expansion that is about 15 per cent less than that of the aluminum alloy with 10 per cent copper that was previously used. Another important advantage of the new alloy is that its specific gravity equals the specific gravity of pure aluminum. Other properties, such as hardness, which may vary from 90 to 130 Brinell, and tensile strength at high temperatures, compare favorably with those of the 10 per cent copper alloy.

These advantageous properties of the new alloy have been obtained by including from 12 to 14 per cent silicon in its analysis, together with small amounts of copper, nickel, and magnesium. This high-silicon alloy was developed some years ago, but until tungsten-carbide tools became commercially available, it was impossible to machine it satisfactorily. The difficulties were due to the abrasive action that the silicon had upon the cutting tools.

Tools tipped with tungsten carbide are used for every operation on the pistons, with the exception of two. One of these is the final operation on the side walls, which consists of grinding the piston slightly cam-shaped around the periphery, so that the wall is 0.0065 inch low at two opposite points on the circumference. The other operation in which tungsten carbide is not used is the boring of the wrist-pin holes. This is done with diamond tools.

To illustrate how hard Lo-Ex aluminum alloy is on the tools, it is merely necessary to point out that in the majority of operations, only 300 pieces can be machined per grind of the tools, whereas 8000 pieces were obtained per grind in the case of the pistons used in previous years.

One of the most difficult problems to solve in planning for the production of these Lo-Ex pistons was the cutting of the expansion slots on the opposite sides, just below the third ring groove. A circular slotting saw, tipped with tungsten carbide, is employed for this operation, as shown in the heading illustration. The saw is 5 inches in diameter, has about 40 teeth, and cuts a slot 1/8 inch wide.

The practice is to grind the saws used for this purpose about once for every 300 pistons. The tungsten-carbide tips can be ground sixty times.

Drills with Tungsten-Carbide Tips and Nitralloy Shanks

Another typical operation in the piston department is shown in Fig. 1. This operation consists of drilling the wrist-pin holes of three pistons simultaneously. Each piston is accurately located for this operation in a fixture that encloses it completely, as shown at the left and in the center, the right-hand fixture being illustrated in the open position so as to enable the piston to be seen.

The tools consist of fluted drills, the shanks of which are made of nitrided steel. Tungsten-carbide tips are brazed to the cutting end of the

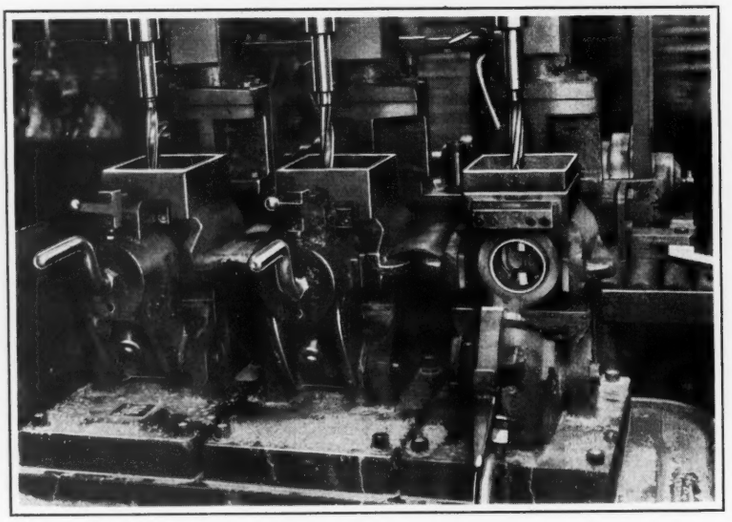


Fig. 1. Drills Made of Nitrided Steel and Having Tungsten-Carbide Cutting Edges are Employed for Drilling the Wrist-pin Holes of the Lo-Ex Pistons

fluted portion. Nitralloy bushings are used for guiding the drills. In this operation, it is only necessary to regrind the tools about every 1500 pieces; before the Nitralloy shanks and bushings were used, they had to be reground every 300 pieces. The longer tool life is due to the reduced wear of the Nitralloy shanks and bushings.

* * *

Pressures Required for Heading Duralumin Rivets

By GEORGE A. FRIES

During the last few years there has been a constant increase in the use of metals in aircraft construction. The exacting requirements in this field necessitate the maintenance of high strength-to-weight factors. For this reason, attention has been focussed on the light alloys of aluminum and magnesium, which show good resistance to corrosion and erosion. Much time has been devoted to developing and designing various odd sections in order to obtain the highest efficiency possible with these materials. Efficient means for joining these sections together are also necessary, and for this purpose, rivets of duralumin are being used.

The "Dural" rivet has become a standard among the builders of aircraft because of its light weight and great strength. For this reason, it is important to know the pressures required for forming the heads of the various sizes of Dural rivets. It is noted that each length of rivet has a specified maximum and minimum grip length, the grip length being equal to the combined thickness of the parts to be riveted together. The pressure required to form a rivet head when minimum gripping length is used would obviously be greater than when the maximum gripping length is allowed. This is made clear by the following example and the accompanying illustration.

Example—A rivet 0.350 inch long has a minimum grip of 0.120 inch and a maximum grip of 0.141 inch, as shown in the illustration. In forming the head of the rivet with a grip of 0.120 inch, more metal has to be compressed than when the grip is 0.141 inch.

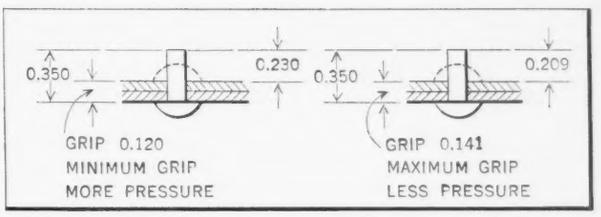
Average Pressure Required to Head "Dural" Rivets

Rivet Size	Condition of Rivet*	Thickness of Sheet,† Inches	Condition of Sheet	Average Pressure, Pounds	Number of Tests
1/16	Annealed	1/16	Heat-treated	870	3
1/16	Heat-treated	1/16	Heat-treated	920	3
3/32	Annealed	1/16	Heat-treated	1350	3
3/32	Heat-treated	1/16	Heat-treated	1725	3
1/8	Annealed	1/16	Heat-treated	2730	3
1/8	Heat-treated	1/16	Heat-treated	2890	3
5/32	Annealed	1/16	Heat-treated	3030	3
5/32	Heat-treated	1/16	Heat-treated	3130	3
3/16	Annealed	1/16	Heat-treated	3710	3
3/16	Heat-treated	1/16	Heat-treated	4490	3

*The heat-treated rivets were formed within thirty minutes after heat-treatment.
†Two thicknesses of plate were used in each test to give a grip of 1/8 inch.

The pressures vary considerably with the location of the dies; that is, if the dies are kept in line, more pressure is required than if they are tilted so that the rivet bends slightly. The results of some actual tests are given in the accompanying table. As previously stated, each rivet length has a specified minimum and maximum grip. The rivets used in making the tests from which the values given in the accompanying table were obtained had a grip of 1/8 inch.

All rivets used in the construction of aircraft are heat-treated and worked within thirty minutes after the heat-treatment. This practice applies to duralumin, which, on being heat-treated, is as soft as it is in the annealed state. After thirty minutes, however, it will age and become hard, attaining its specified physical properties.



Diagrams of Rivet Assemblies having Minimum and Maximum Grips

The heat-treatment for these rivets is as follows: (a) Heat in a salt bath or electric muffle furnace to about 930 degrees F., and hold this temperature for twenty minutes, or long enough to insure thorough heating of all the rivets. (b) Remove and quench in warm water. Any salt adhering to the work must be thoroughly washed off to prevent corrosion.

* * *

Comment on Mechanism Article

By M. JACKER

Referring to the mechanism illustrated and described on page 740 of June MACHINERY and the comments made on page 850 of July MACHINERY, the writer has gone over the pin and slotted-disk driving mechanism more minutely and finds that its action should be as smooth and uninterrupted as any pair of well made gears. The slight discrepancy caused by using the nearest fraction, in giving dimensions of the pin circle to a fraction of an inch, makes the radius of the pin circle 0.00027 inch shorter than it theoretically ought to be. This is too insignificant to cause any trouble.

* * *

Rotary automatic polishing and buffing machines, built either for single-purpose operations or as general-purpose machines, permit round, flat, or beveled work to be polished by the use of simple adapters. Automatic devices feed composition paste to the polishing and buffing wheels, thus making the operation wholly automatic.

Special Tools and Devices for Railway Shops

Recommended by Railway Shop Superintendents and Foremen

Equipment for Holding Cross-Heads while Welding Pin-Holes

By E. A. LOTZ, Foreman
Pennsylvania Railroad Shops, Juniata, Pa.

Locomotive cross-heads of the duplex type are reclaimed by building up the worn pin-holes with a welding torch and then machining the holes to the correct size. To facilitate handling the cross-heads during the preheating and welding operations, the writer designed and built the equipment shown in Fig. 1, thus effecting a 40 per cent saving in labor over former methods of handling.

With this arrangement, the cross-head is easily placed in and removed from the preheating furnace. In addition, it can be rapidly placed in various positions for welding, and two welders can work on two different parts of the cross-head at the same time.

The equipment, which is practically welded steel construction throughout, consists of the truck base *A* and the adjustable arm *B*, at the overhanging end of which is a swivel *C*, shaped to receive the top ways of the cross-head. The cross-head (not shown in this view) is clamped in position in the swivel by two set-screws.

Arm *B* is attached to a length of pipe *K*, which is supported at the right-hand end by the trunnions *D* and at the other end by the ring *E*. This ring can be adjusted vertically to raise the cross-head from the skids or furnace floor by turning the hand-wheel on the jack-screw *F*. Counterweight *G* is fixed to the pipe in position to balance the arm and swivel. Counterweight *H* has two adjustments, one along the small pipe *J* and the other about the pipe *K*. The latter adjustment provides a means of balancing cross-heads of different sizes which vary in weight.

Fig. 2 shows the various positions of the cross-head while being preheated and welded. The cross-head is placed in the furnace in position *A*. After being preheated, it is removed from the furnace and swiveled to position *B* for welding the bores of the pin-hole. Two welders can be employed simultaneously—one at each side of the cross-head. After this operation, the arm is swung 90 degrees on the axis of pipe *K*, Fig. 1, by the ratchet lever *L* until the cross-head assumes the position indicated at *C*, Fig. 2, where the lower inside face of the hole is built up. The arm is then swung 180 degrees about the axis of pipe *K* to build up the opposite face.

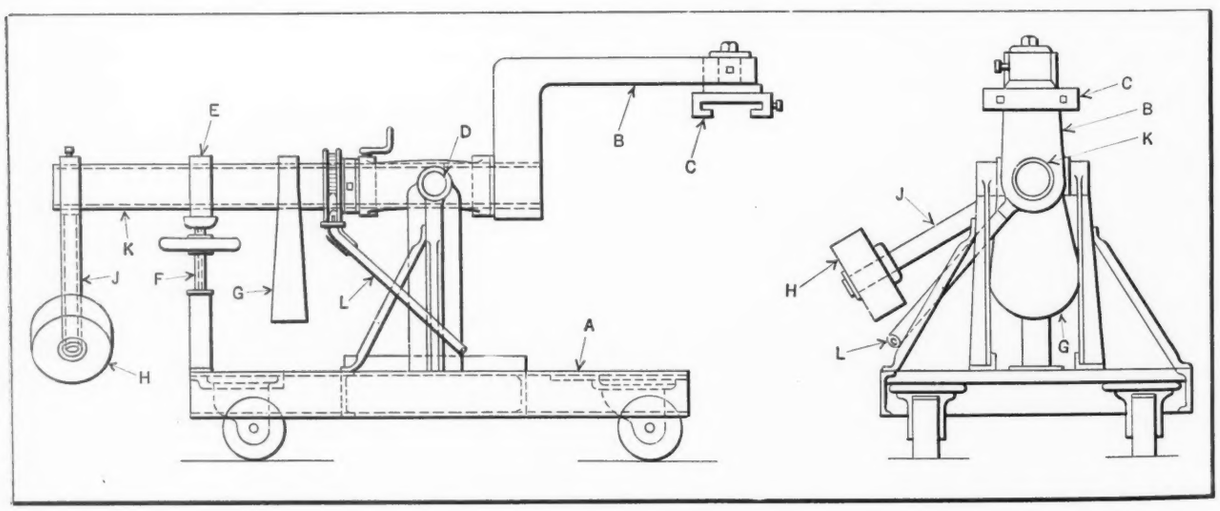


Fig. 1. Portable Equipment with Adjustable Arm for Holding Cross-head in Various Positions for Preheating and Welding

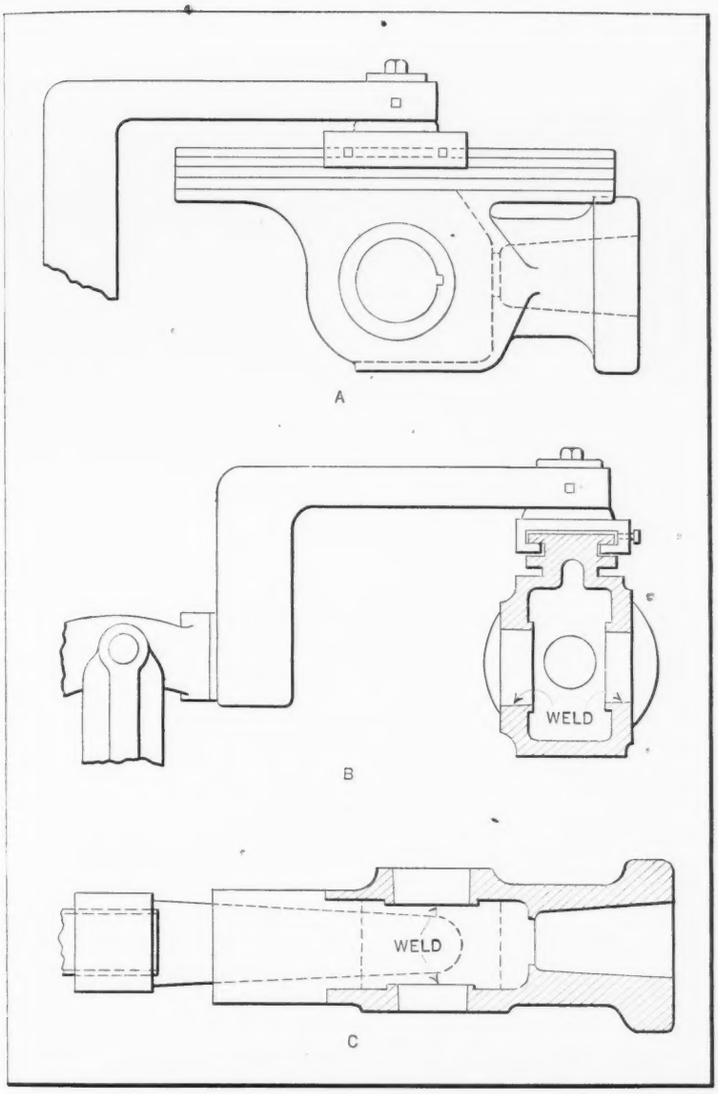


Fig. 2. Positions of Cross-head and Holding Arm while Preheating and Welding the Pin-hole

Driving Staybolts from Both Ends at the Same Time

Tight staybolts are insured in the fireboxes of boilers used on the locomotives of the Canadian National Railways by driving the staybolt heads simultaneously from both ends. The illustration shows such an operation in the Stratford, Ontario, shops of the railway mentioned. It will be seen that the air tool is suspended from a light overhead hoist and backed up at the rear by a heavy wooden plank.

With this arrangement, the operator is relieved of all heavy labor. He merely moves a handle during the driving action of the hammer to swivel the tool and obtain a staybolt head of the desired shape. When this tool is in operation on the outside of the firebox, another tool is being operated on the inside against the opposite head of the staybolt.

The second tool is long enough so that the rear end can be backed up by the far wall of the firebox. The tool is suspended from a rod supported at one end in a boiler-tube hole and at the other end in an arch-tube hole. The plank used with the outside hammer is adjustable up and down on steel posts so that it can be placed in position to suit all the staybolts. The hammers have a 9-inch stroke and operate on an air pressure of from 90 to 110 pounds per square inch. Their cylinders are about 2 1/2 inches in diameter.

Not only are the staybolts made watertight by this method, but they are also driven in minimum time and without exertion on the part of the operator.

O. H.

* * *

The Westinghouse Company Awards Scholarships

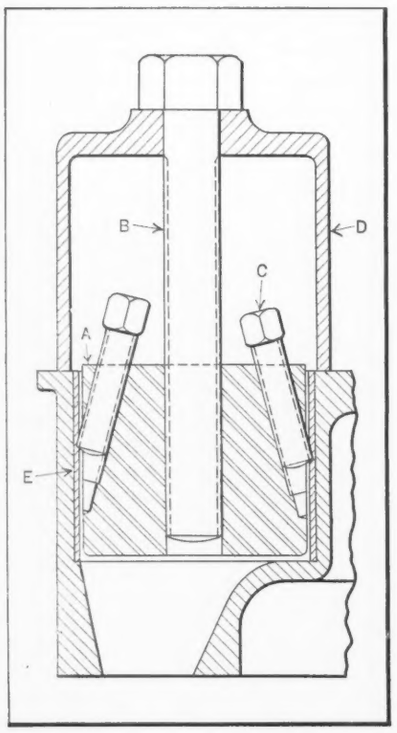
The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has just awarded four annual scholarships in a competitive examination of seventy-seven candidates. The winners are: Marshall Dann, Sharon, Pa., who will attend the Worcester Polytechnic Institute; George W. Nagel, Wilkinsburg, Pa., who will attend the Carnegie Institute of Technology; Alan S. Compton, Collingsdale, Pa., who will attend the Drexel Institute; and Francis V. Giolma, New York, who will attend the Carnegie Institute of Technology. This is the fourteenth consecutive year during which four Westinghouse scholarships have been awarded as a memorial to the company's employes who were in the service during the World War. The scholarships are awarded to sons of employes and younger employes of the company.

Firebox Staybolt Being Driven from Both Ends

Puller for Removing Thin-Walled Liner Bushings

By F. E. FICK

In one plant, a number of fluid meters were made in which the cylinders were lined with brass tubes, 2 1/2 inches inside diameter, with walls 1/16 inch thick. After assembly, it was found that, due to an insufficient amount of shellac being placed on the liners before pressing them in place, there was a leak between the housing and the liner. On this account, it was necessary to pull the liners out and replace them with ones that had been properly shellacked. This presented a difficult problem, as the cylinder bore was a blind hole, so that the liners could not be pushed out. The difficulty was overcome, however, by using the puller illustrated in the engraving.



Bushing Puller in which the Bushing is Gripped by Two Set-screws

The puller consists of a head *A*, draw-screw *B*, two set-screws *C*, and the hollow cap *D*. The diameter of head *A* is about 0.01 inch less than the inside diameter of the liner indicated at *E*. To use this device, the head *A* is inserted in the liner as shown. Set-screws *C* are then screwed down until they project beyond the sides of the head and "bite" into the liner. It is only necessary, then, to place the cap *D* over the liner and insert the screw *B* in the head. By turning this screw, the head with the liner attached is drawn out of the cylinder block and up into the cap. This type of puller can, of course, be adapted to other work of similar nature.

* * *

Forming a Helical Groove on a Wooden Pattern

By O. S. MARSHALL

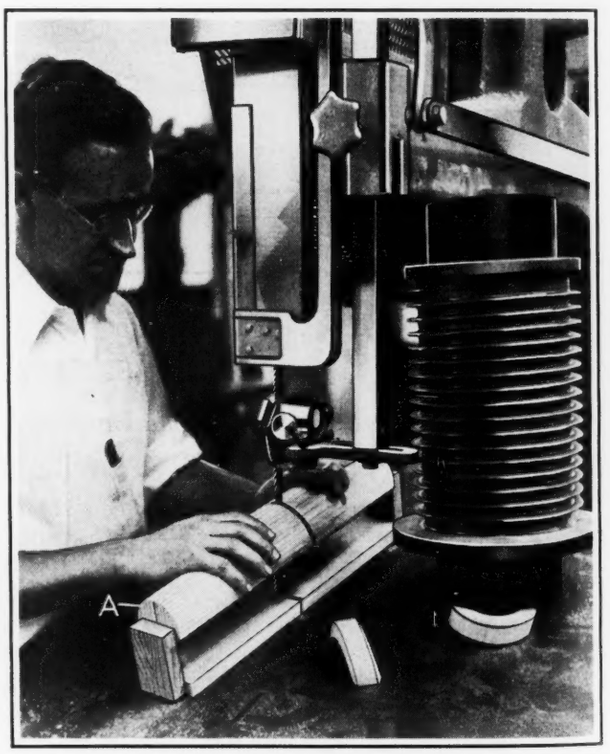
In making the pattern for the grooved cylinder shown in the illustration, the grooves were formed by a series of helical wooden strips attached to the cylindrical surface of the pattern. The purpose of the grooves is to provide a support for a coiled copper tube. Hence, they do not require a precision form.

The helical strips are formed on a band saw. First, however, a hollow cylinder with walls having a thickness equal to the depth of the groove is sawed in half along the axis of the cylinder. One of these half-cylinders is then placed on a semi-circular wooden bar similar to the one indicated at *A*. Although this set-up is for a smaller cylinder, the principle is the same for a larger one.

The bar *A* is stationary and a clearance slot is cut through its center for the saw. The diameter of the bar is equal to that of the cylinder bore, and it is supported on the band saw table by a wooden bracket. The table is tipped to correspond with the slope of the sides of the thread and the bar *A* swung around so that the angle formed by its center line and the side of the saw is equal to the helix angle.

To make the strips, the required widths are laid off along the half-cylinder. The cylinder is then slid along the bar *A* until the first line is opposite the saw. By rotating the cylinder on the bar the end is cut to form a helical contour.

The position of the cylinder on the bar is now reversed and the second line located opposite the saw. Then the cylinder is again rotated against the saw and the first strip is cut off. Two of these strips are shown lying on the machine table. By reversing the position of the cylinder on the bar after each cut, the angles of the sides of the strip converge as required.



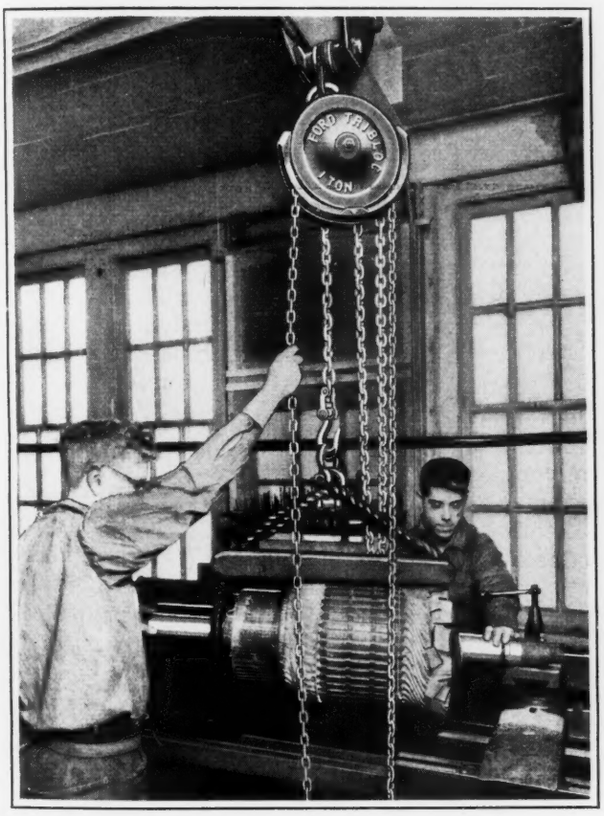
Cutting Helical Wooden Strips from a Hollow Half-cylinder. The Strips are Afterward Attached to a Cylindrical Pattern to Form a Continuous Groove

Does it Pay to Lift Heavy Material "by Hand"?

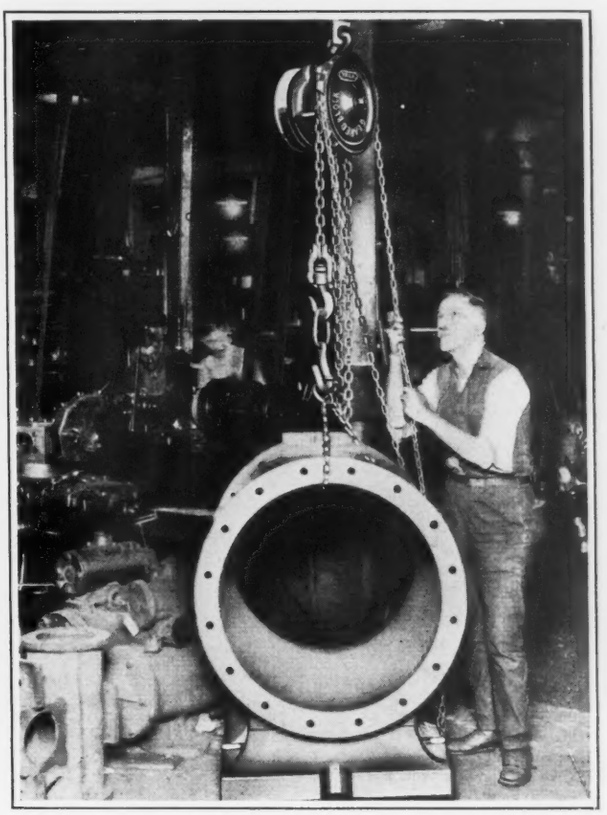
How the Use of Material-Handling Equipment Promotes Safety and Economy in the Shop by Reducing the Chances of Accidents

By W. F. SCHAPHORST

FROM the standpoint of safety in the machine shop, a good general rule to follow is: Do not attempt to lift heavy objects by hand when mechanical means are available. It may be "good exercise" to do occasional heavy lifting. However, most of us do not work for the exercise derived, but for the purpose of earning a livelihood.



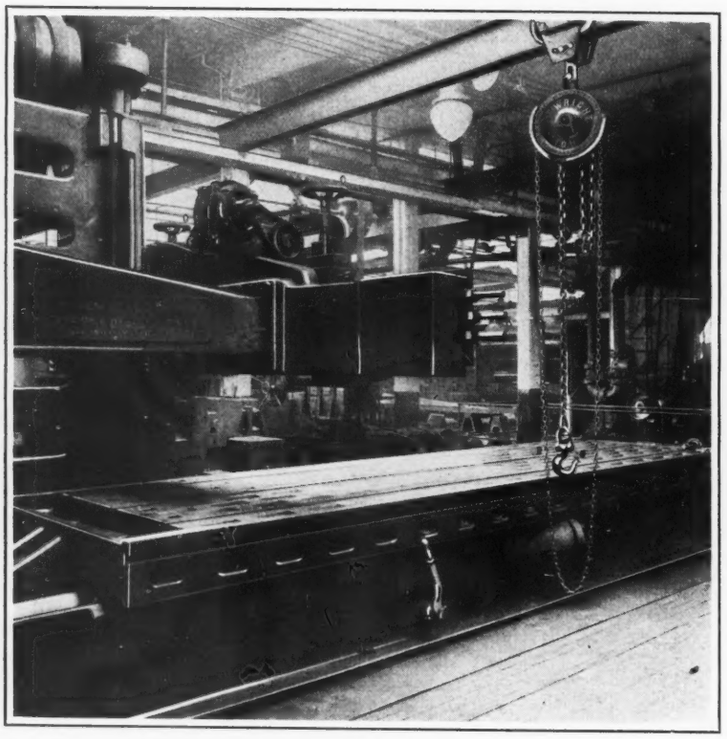
Two Men Could Lift this Rotor by Hand; but Why Risk the Cost of Personal Injuries and Damage to the Rotor, Lathe Bed, and Centers Because of the Relatively Slight Cost of Hoisting Equipment?



Fortunately this Casting is Too Heavy to be Lifted by Hand. Fewer Accidents Occur when This Condition Exists, for the Simple Reason that Mechanical Hoisting Equipment Must be Provided.

Many excellent reasons have been advanced against heavy lifting. Several plants have learned, through actual experience, the advisability of delegating such work to machinery. For example, in one plant, a casting was delivered on a truck to a machinist. The casting was heavy, but not so heavy that it could not be lifted "by hand." The machinist proceeded to lift it. His motive was to "save time." But the casting slipped from his hands and the sharp burred edges on the casting cut one of his hands severely. In spite of the immediate first aid that was administered to him, a serious case of blood poisoning developed. Healing the wound proved to be a lengthy and expensive process. The total cost of attempting to lift one casting without mechanical means amounted to $1200.

Because of this accident, the company decided to be more careful about removing burred edges. This required merely a simple additional operation which has proved to be a worthwhile safety precaution. The best safety measure, however, is to do the heavy handling with machinery whenever possible. Obviously, if mechanical means had been used, the accident referred to would not have occurred.



An Ideal Arrangement—a Hoist that is Always Available for Handling Heavy Work. One Hoist May Serve More Than One Machine. Weigh Its Cost with the Additional Safety Obtained!

In addition to the danger mentioned, there are many others, such as back strains, ruptures, crushed feet, pulled ligaments, and even broken bones. All of these can be and should be prevented by the use of mechanical lifting equipment. The cost of this equipment is invariably much smaller than the cost of physical injury. From a dollars-and-cents angle alone, it pays to "take things easy" when it comes to handling heavy work. Let machinery do it.

* * *

The Memory of an Engineering Pioneer Honored

The hundredth anniversary of the birth of Nikolaus Otto, who may well be considered the founder of modern internal-combustion engine practice, was celebrated at Cologne, Germany, on June 14. Mr. Otto is most generally known as the first engineer to successfully apply the four-stroke cycle of operation to internal-combustion engines, this being known as the Otto cycle. Through this invention, he gave the world the first efficient gas engine, using combustible gas as the working medium, and thereby paved the way for later inventors who have made the internal-combustion engine one of the most important power sources for transportation on sea, on land, and in air, as well as an important source for industrial power. His contribution to engineering was one of great importance.

A Few Points on Chromium-Plating Practice

Metals have been plated with chromium by different experimenters since the middle of the last century, but only within a comparatively short time has the process of chromium-plating been considered of commercial importance. Chromium-plating is used for three purposes—to improve the appearance of an article, to prevent corrosion, and to resist wear. Generally, only a thin chromium plate is required to form a tarnish-resisting coating over metals, or over other plating such as copper or nickel. However, the nickel and copper plating over which chromium is to be applied should be at least 0.0004 inch thick, in which case a plate of chromium of sufficient thickness can be obtained in from three to five minutes. To secure the best results, when using chromium plate for a wear-resisting surface, the chromium should be applied in relatively thick layers and the metal on which it is deposited should be as hard as possible.

The current density and the temperature are the two important variables in the operation of a chromium-plating solution. The baths usually employed produce a bright deposit over polished surfaces at a current density of 150 to 200 amperes per square foot and a temperature of from 50 to 60 degrees C. (122 to 140 degrees F.). Too high a current density produces a burnt or satin finish while too low a current density gives a bluish plate or fails to cover. Variations in temperature produce like results.

The piece to be plated, whether steel, nickel-plated steel, copper or brass, is generally cleaned first in an alkaline cleaner, with or without the use of electric current. It is then rinsed in water, dipped in hydrochloric acid, rinsed again, and immediately placed in the chromium bath while still wet. If a polished chromium surface is required, the article should be polished and buffed before cleaning.

When plating a nickel deposit with chromium, some trouble may be experienced from the nickel peeling. This is best overcome by plating a heavy deposit of nickel from a hot solution. When plating chromium over nickel, it is necessary to keep the hydrochloric acid dip from becoming contaminated with copper; otherwise, a thin film of copper will form over the surface of the nickel and prevent the chromium from adhering perfectly. Chromium solutions have poor "throwing power"—that is, they will not plate into deep recesses. Therefore, if pieces of irregular shape are to be plated, it may be necessary to use anodes of approximately the same shape as the pieces to be plated. Better results are likely to be obtained in that way.

Notes and Comment on Engineering Topics

Great strides have been made during recent years in compounding rubber to resist the action of more than one hundred corrosive chemicals, oils, greases, fats, and organic solvents. Rubber has also been developed that resists the deteriorating effects of high temperatures up to 250 degrees F., according to a paper read by Dr. H. E. Fritz and J. R. Hoover of the B. F. Goodrich Co. before the American Society for Testing Materials.

Electric arc welding is being utilized for rebuilding old bridges in Chester County, Pa. One of these bridges was originally erected in 1887. It has given good service in the last forty-five years; but inasmuch as it was originally built for two-ton capacity, it is not heavy enough to carry the loads of modern traffic. The structure has been redesigned, all new connections being made by means of the welding process, so that the bridge, when completed, will carry loads up to fifteen tons. All the floor beams and girders were strengthened by means of cover plates and stiffeners welded to the old members.

In order to make corrosion tests on welds, the Westinghouse Electric & Mfg. Co. has developed a special corrosion testing device that greatly hastens the slow process of rusting. In it the test specimens are subjected to intermittent immersions in a corroding liquid. The apparatus automatically immerses the samples for a definite period, and then removes them and exposes them to the air for another period. Specimens are moved only when being lowered or raised each time, which is but a small fraction of the cycle. In this way, it is hoped to be able to determine how to fabricate welded structures so that all parts will be uniformly resistant to rust.

Ore Cars Built from Aluminum Constitute One of the Latest Developments in Freight-car Construction. By the Use of Aluminum, Less Weight Goes Into the Car and More Into the Pay-load

EDITORIAL COMMENT

A Rise in the Price Level is a Sign to be Welcomed

The best thing that can happen in industry and commerce at present is a steady increase in prices. The price level is altogether too low to make healthy industrial activity possible. An increase in the prices of materials, as well as of finished products, would encourage industrial activity and enterprise, stimulate confidence, move stagnant supplies of materials and finished products, increase opportunities for employment, and in general, bring about a gradual return of the kind of business activity that should be normal for a nation blessed with all the opportunities of these United States.

A rising price level, therefore, will not be opposed by farseeing manufacturers. No one, of course, wants to pay more than he has to for anything; but during the past year or so, there has been a decided tendency to avoid paying even a fair market price. When prices were inflated as they were some three or four years ago, vigilant buying practices were in order. With prices deflated as they are now, no one is helping even his own business by trying to force prices down still further.

The Success of Industry Is not Wholly a Problem of Engineering

The alertness of the American manufacturer and engineer in taking advantage of every mechanical improvement is recognized throughout the world. American engineers have become famous for scrapping tradition. They leave no stone unturned in investigating every possible avenue of approach to a new problem; and when their investigations are completed, our manufacturers are quick to adopt the findings. The result has been a remarkable record of productive capacity.

Yet we have to contend with periodic ups and downs in the business cycle. Is it not likely that if economic facts were ferreted out and scrutinized with the same thoroughness as engineering facts, we would be in a position to master business problems as readily as we solve mechanical ones? When something is wrong with a machine, we determine the cause of the trouble and set about to remedy it; but when something goes wrong with the business engine, when it begins to miss and sputter, we sit back and say that if we wait long enough it will begin to run again.

There is no good reason for this. Economic problems are susceptible of experiment and logical deduction, the same as mechanical ones; and the success of industry depends as much upon correct economic knowledge as upon accurate engineering information.

In engineering, we refuse to concede to tradition; in business and economics, we accept tradition almost without question. Take the matter of taxation and fiscal policies, for example. There is no greater power in the hands of government that can be used for stimulating or retarding business and industry than the power of taxation. Yet, we accept present fiscal policies almost as final. We have been brought up on them, and we hardly give a thought to the fact that the accepted principles of taxation may be unscientific and, therefore, harmful in their effects.

If manufacturers and engineers would give to economic problems but a small fraction of the thorough attention that they give to engineering problems, it is likely that industry would be guided along an entirely different course in the future from the one along which it is now guided by tradition.

There is a Reason for the Growth of the Tool Shop

The value of the service rendered by the tool and contract shop has frequently been pointed out in MACHINERY. These shops are specialists in the designing and building of tools, dies, and equipment, and hence can do this work cheaper and better than the comparatively small toolrooms of individual manufacturing plants. The tool and contract shop employing designers and toolmakers with broad training, constantly engaged in high-class tool work, is in a position to give dependable manufacturing advice as well.

The big automobile companies were among the first plants to recognize the value of the tool shop, and during the past year many of these shops have depended almost entirely on the automobile industry for what business they have been able to get. Shops making sewing machines, typewriters, hardware, engines, pumps, electric motors, washing machines, or jewelry can be served equally well by the tool and contract shop. In few fields are the requirements for accuracy and economy greater than in the automobile field; and if the tool shop has been able to meet the exacting requirements of this industry satisfactorily, it certainly should be able to meet the requirements in other fields.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

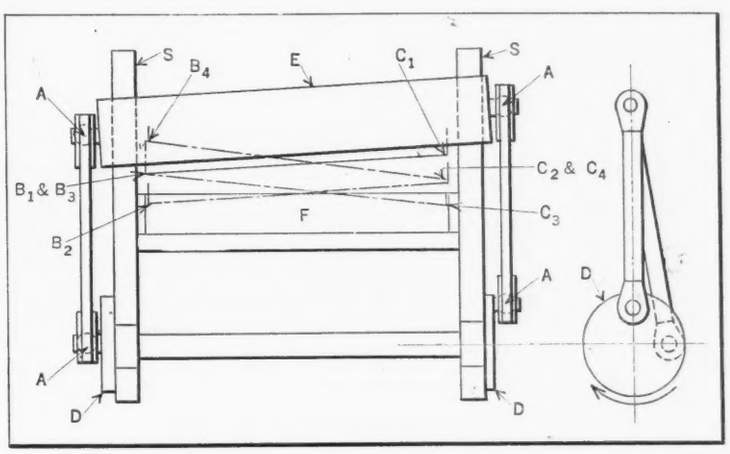
Wabble Movement Mechanism

By OTTO R. WINTER

The wabble mechanism shown in the accompanying illustration was applied to a shearing machine to obtain an action approximating that of hand-operated shears. The mechanism is arranged to make one complete cycle of movements automatically when the driving clutch is engaged. The sides *S* of the shearing machine serve as guides for the cross-bar *E* which supports the movable blade above the stationary blade *F*. As the crank disks *D* revolve, the ends of the movable blade are carried to different positions, as shown at points B_1, B_2, B_3, and B_4 on the left, and by C_1, C_2, C_3, and C_4 on the right. When the left-hand end of the blade is at B_1, the right-hand end is at C_1, and when the left-hand end is at B_2, the right-hand end is at C_2, and so on. This wabble or shearing action is obtained by locating one of the crankpins 90 degrees ahead of the other.

The successful operation of the mechanism is made possible by the spherical pin and connecting-rod bearings *A*. These bearings were easily produced from soft steel balls purchased from stock and bored out to a press fit on the bearing pins. The boxes at the ends of the connecting-rods were formed by pouring babbitt over the balls while the two parts were mounted on a surface plate in their proper relative positions. A few strokes with a soft-faced hammer served to loosen up the bearings sufficiently to permit them to operate satisfactorily.

Grease lubrication is provided by a hole drilled through the bearing after the babbitt was poured. This hole crossed another hole leading from the outer end of the pin. Side motion of the holder *E* is prevented by using curved guides having sufficient clearance to prevent binding. Machines equipped with this shearing mechanism are used in connection with the production of cotton batting and similar fibrous parts.



Mechanism for Producing Shearing Motion

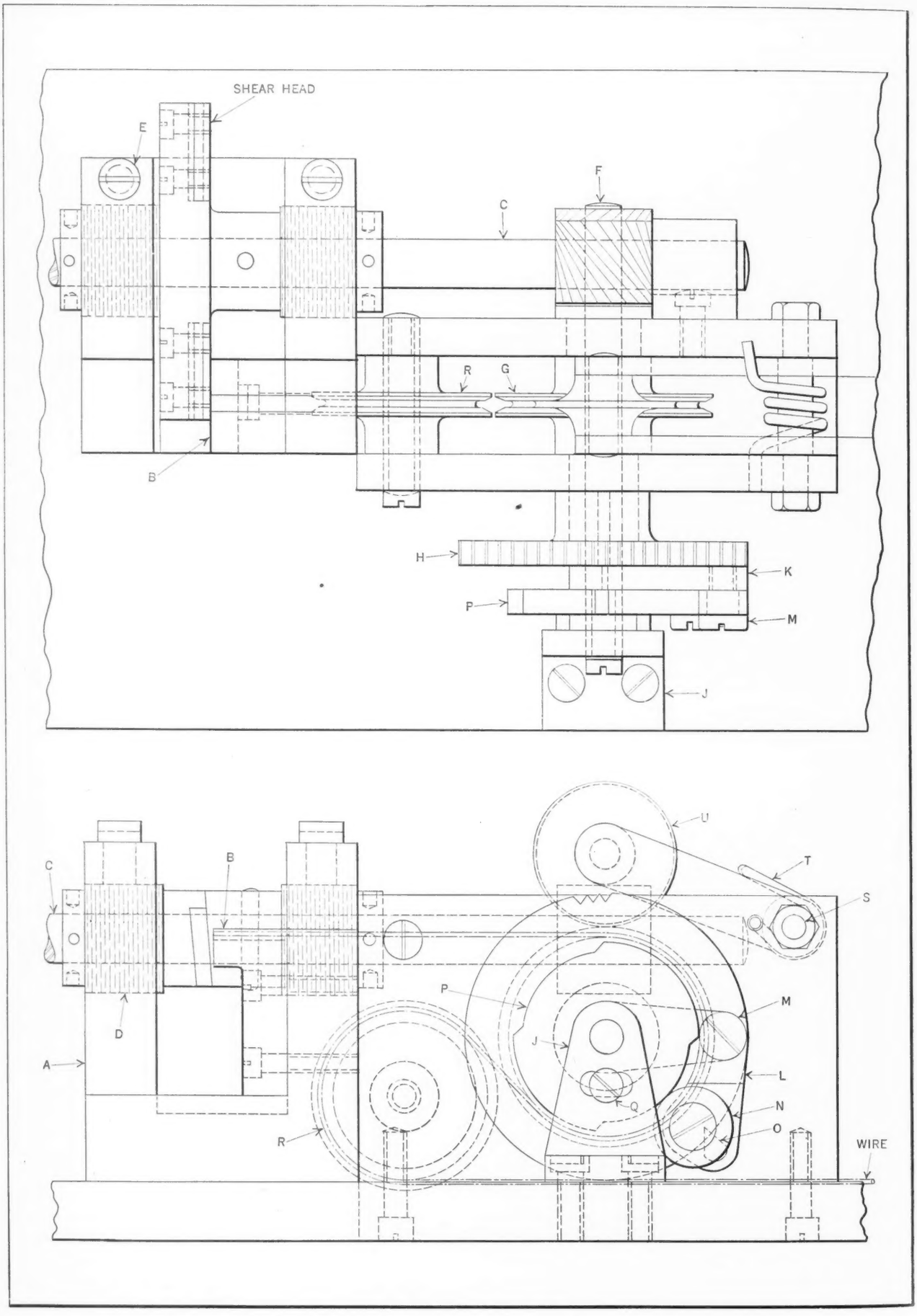
Intermittent Mechanism for Feeding Wire to a Cutting-off Machine

By EUGENE L. SOLTNER

In the plant where the writer is employed, short pieces of twisted wire, approximately one inch long, are used in the product manufactured. Measuring and cutting off these short lengths by hand was found to be a slow and unsatisfactory process; hence the machine shown in the illustration (see next page) was designed to do this work automatically. It consists essentially of a mechanism for feeding the wire intermittently to two rotating shear blades.

All the working parts of the machine are mounted on a steel baseplate. Bracket *A* provides a support for the fixed shear blade *B* and also contains a double bearing for the shaft *C* on which the rotary shear blade head is mounted. It will be noted that bracket *A* is threaded to receive the two bronze bearing bushings *D* for shaft *C*. These bushings provide the necessary adjustment for setting the blades of the rotating shear head close to the stationary blade *B*. After this adjustment is made, the bearing bushings are locked in position by tightening the screws *E*.

Shaft *C* is driven by a 1/4-horsepower motor through reduction gearing, and drives the shaft *F* by means of helical gears. Shaft *F* runs free in the grooved roll *G* and the ratchet wheel *H*, and has an outboard bearing in the bracket *J*. Keyed to shaft *F* is the feed-crank *K*, and connected to this crank is the link *L*. This connection is made by the screw *M*, which



Machine with Intermittent Feed which Cuts off Wire at the Rate of 120 Pieces per Minute

also serves as a pivot on which link *L* oscillates. Secured to the head of screw *M* and to the link *L* is a spring, the purpose of which will be explained later. This spring, which has been omitted to avoid confusion, is of the "mouse-trap" type and is wound around the head of the screw *M*.

At the lower end of link *L* is secured the roller *N* and the feed pawl *O*. The pawl engages the ratchet wheel *H*, while roller *N* rides upon the periphery of cam *P*. Cam *P* is a running fit on the hub of feed-crank *K*, and is prevented from turning by screw *Q*. Roll *G* is keyed to the ratchet wheel *H*.

The manner in which the feeding movement is imparted to the ratchet wheel and roll *G* is as follows: As shaft *F* revolves, the feed-crank *K* and its connecting members *M*, *L*, *N*, and *O* are carried around cam *P*. Roller *N* is forced to maintain contact with the cam by means of the "mouse trap" spring previously mentioned. The cam has two low places corresponding to the feeding intervals.

As roller *N* drops into these low places, the link *L* is pulled toward the center of the cam, carrying pawl *O* into engagement with the ratchet wheel *H* and thus rotating the ratchet wheel and roll *G*. This movement continues until roller *N* engages the high part on the cam and is forced outward, carrying link *L* outward also, and disengaging pawl *O* from the ratchet wheel.

In operation, the end of the wire is carried by hand under and over idler roll *R*, under and over feed-roll *G*, through a short piece of tubing (not shown) to keep it from buckling, and then over the edge of fixed shear blade *B*, where it is cut to length by the blades in the rotating head after the machine is started. Idler roll *U*, mounted on two arms pivoted on the stud *S*, serves to exert a pressure on the wire against roll *G* through the medium of spring *T*. This provides the necessary traction to pull the wire from the reel, which, although not shown, is located on the steel baseplate at the right.

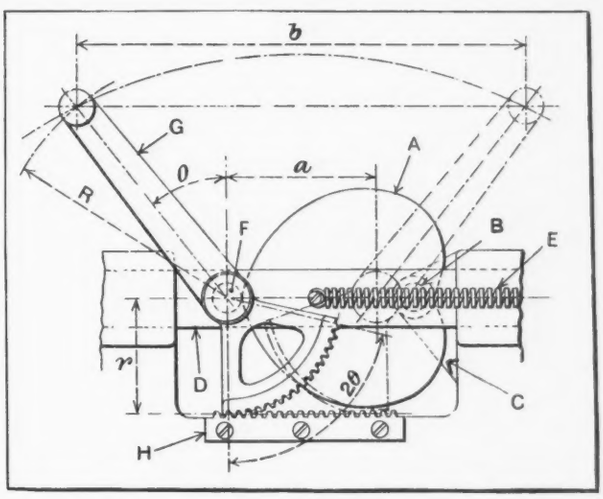
Ninety-nine teeth were cut on the ratchet wheel, so that all the teeth would come into action. In this way, the wear is distributed over all the teeth. These teeth have a face angle of 15 degrees to permit the pawl to disengage readily under load. Any feeding movement from 1/99 of the circumference of the roll *G* to approximately one-half this amount can be obtained by substituting suitable plate cams.

As cam *P* has two low places on its periphery, it is obvious that two feeding movements take place for every revolution of shaft *F*. Through reduction gearing, shaft *C* operates at 60 revolutions per minute, cutting two wires at each revolution, or 120 wires per minute. Thus for a period of eight hours, the production is approximately 57,000 wires.

Cam and Rack Mechanism for Increasing the Movement of a Lever

When compactness is essential in a mechanism for producing a long movement with a short lever, the design shown in the illustration may be used to advantage. The lever indicated at *G* is pivoted to a slide *D* confined in the guides of the machine. Cast on the lower end of the lever is a gear segment which meshes with a stationary rack *H*. Movement is imparted to the slide by the continually rotating cam *A*, which is mounted on a shaft in the stationary bracket *C* and engages roll *F* on the lever stud. Coil spring *E*, fastened to the slide and the machine frame, serves to hold the roll in engagement with the cam.

As the cam rotates in a clockwise direction from the position indicated, the slide *D* will move toward the right. The lever will, of course, travel with the slide, and owing to the engagement of the gear segment and the rack, will swing in a clockwise direction. The lever will continue to swing in this direction until the cam has carried the slide to its extreme position at the right. The position of the lever at this point is indicated by the dot-and-dash lines.



Combination Cam and Rack Movement for Increasing the Throw of a Lever

In determining the movement *b* of the upper end of the lever, it is only necessary to add the throw *a* of the cam to the normal angular movement of the lever, all measurements being taken horizontally. The movement of the lever can be varied by changing the throw of the cam, the pitch radius *r* of the segment gear, or the length *R* of the lever itself.

L. H. L.

* * *

We are ready for some brand-new economic pioneering, and the man with courage and vision is the man who will lead the way in the days to come. A magnificent opportunity lies before the industry and its leaders that face the facts of today with initiative, resourcefulness, and constructive aggressiveness. Men and organizations with these characteristics will not be content to turn America back to the Indians—to confess failure. They will face the facts and conquer. They are already at work. —*Frederick M. Feiker*, Director, Bureau of Foreign and Domestic Commerce

Economical Milling Procedure Developed by Engineering Study

By Careful Planning, a Marked Increase in Production Has Been Obtained in Milling Cylinder Heads for Lycoming V-Type Automobile Engines—Third Article

IN July and August MACHINERY, pages 827 and 891, respectively, were described the methods employed at the plant of the Lycoming Mfg. Co., Williamsport, Pa., for milling V-type cylinder blocks. The present article describes the milling operations performed on cylinder heads used on the V-type blocks. The Hydromatic machines and fixtures illustrated in this and the preceding articles were built by the Cincinnati Milling Machine Co., Cincinnati, Ohio. Many features of these machines are protected by U. S. and foreign patents.

The first operation performed on the cylinder head consists of milling the cylinder contact face on the plain Hydromatic machine equipped as shown in Fig. 1. The fixture is designed to permit easy and quick removal of the work. With this equipment, a true flat surface within the required limit of 0.001 inch is obtained in one cut with a tungsten-carbide face mill, using a feed of 15 inches per minute. The fixture is so designed that no twisting stresses are placed on the work while it is being clamped. Three fixed side stops are used, and two fixed pads support each end of the work. Two-position hand clamps locate the work properly, after which the three quick-adjustable jacks are locked in place. The work is then rigidly secured by means of clamps actuated by the three pilot wheels.

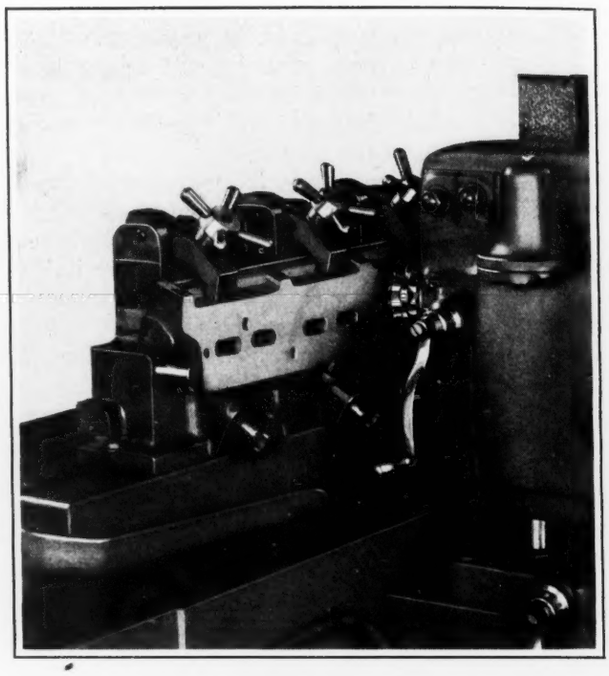
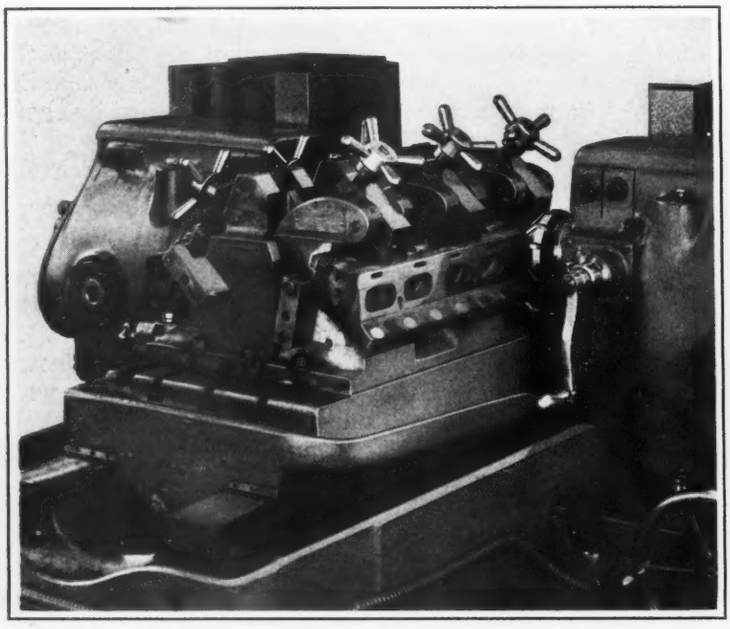


Fig. 1. Plain Hydromatic Machine Set up for Milling Bottom of Cylinder Head for V-type Engine

The work is so positioned that the locating surfaces are kept free of chips. The production on this machine can be doubled by converting it into a duplex type. This is done by adding an upright and a spindle carrier and drive on the left-hand side of the bed-table unit. A fixture similar to the one shown is mounted on the opposite side of the table. The bases of the two fixtures can be interlocked at the center of the table.

Fig. 2. Duplex Hydromatic Equipped for Milling Manifold and Valve Cover Faces, and Bosses of Cylinder Head



Second Operation on Cylinder Head

The second operation on the cylinder head consists of finish-milling the manifold contact face, the valve cover face, and the bolt lugs. This work is performed on the machine shown in Fig. 2. Actually, two operations are performed on this machine, the work being transferred from one fixture to the other. The fixture on the left-hand side of the machine table holds the work while the

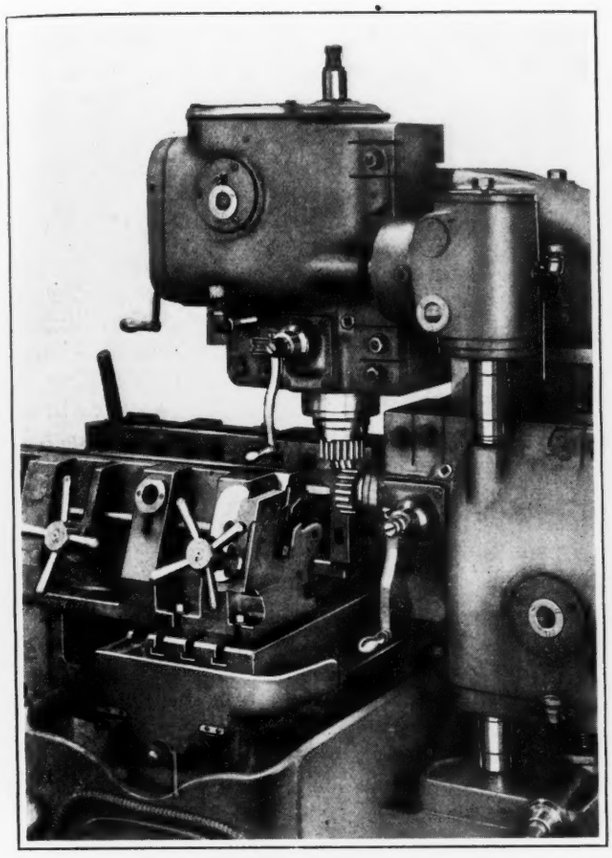


Fig. 3. Equipment Employed in Milling Both Ends and the Oil-seal Pads of the Cylinder Head

manifold contact face is being milled. After this operation, the cylinder head is moved to the right-hand fixture for milling the valve cover face and the bolt lugs.

In both fixtures, the work rests on the finished cylinder contact face and is located by two dowels. The work is clamped on the top surface by quick-acting clamps operated by pilot wheels. The location of the work is quickly obtained by placing it over the dowel-pins. It will be noted that the work and cutters are so positioned that the chips cannot reach the locating surfaces. Stellite cutters are used for the angular cut.

Third Operation on the Cylinder Head

The third operation on the cylinder head consists of finishing both ends and the oil-seal pads. For this work, an open-sided plain Hydromatic is used. This machine, as shown in Fig. 3, has one horizontal and one vertical spindle. Either four or six surfaces are milled in one cut, depending on which end of the cylinder head is being machined.

By mounting two fixtures on the machine table and using the reciprocating method of milling, almost continuous production is obtained. The operator loads the piece in one fixture while the piece in the other fixture is being milled. In one fixture, six surfaces are finished on one end of the cylinder head, and in the other fixture, four surfaces are finished on the other end.

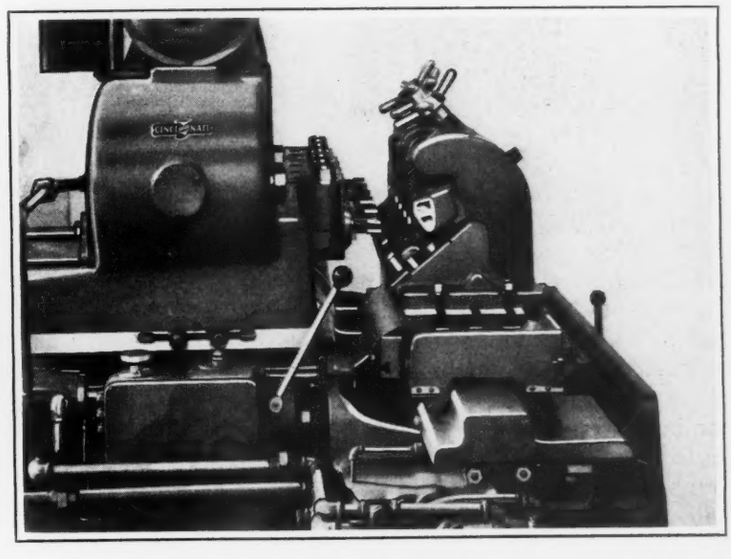
This machine is built up from standard units, and is provided with dial adjustments for positioning the cutters both endwise and transversely. The fixtures are designed to allow the work to be easily slid into position.

Fourth or Final Milling Operation on Cylinder Head

The fourth operation consists of milling the six elongated openings in the cylinder head that provide clearance for the insertion of the valves. Since the valve covers fit into these openings, they must be held within accurate limits with regard to width and length. This work is performed on the machine shown in Fig. 4. It consists of a standard bed-table unit and a special six-spindle cross-sliding head mounted on a fixed-height slide base. The spindles are driven by a motor mounted directly on the head.

All movements of the table and cross-slide head are hydraulically operated through the medium of the standard hydraulic unit of the machine, with the addition of special valves and dogs to secure a completely automatic cycle. The movements obtained by this automatic control of the hydraulic system are as follows: (1) The table is located at the extreme right against a positive stop; (2) the six-spindle head moves inward under rapid traverse; (3) the head is fed to depth; (4) the head is returned to the starting position under rapid traverse; (5) the table is traversed rapidly to the positive-stop position at the left of the machine; (6) the head moves inward under rapid traverse; (7)

Fig. 4. Special Six-spindle Head Used on Hydraulically Operated Machine Employed for Milling Elongated Openings



the head is fed to depth; (8) the table is fed to the left for finishing the opening to the required length; and (9) the head is traversed rapidly outward to the stop position.

The four-blade cutters used for milling the slots can be accurately adjusted to the required diameter. The production on this job is forty pieces per hour.

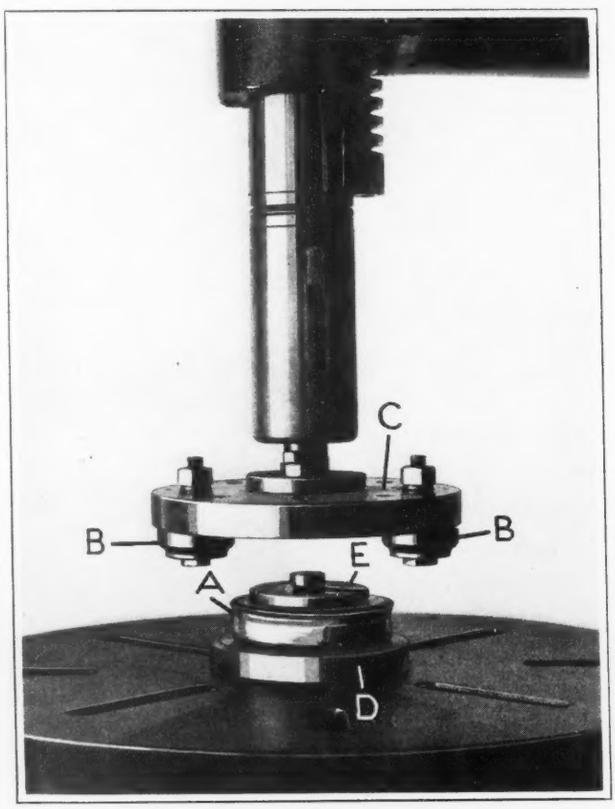
* * *

Spinning Back the Edge of Steel Shells

The two races and ball retainer of a ball thrust bearing made for automotive service by the Bantam Ball Bearing Co., South Bend, Ind., are held together by means of a cup-shaped sheet-metal cap. In the assembly operation, the ball-bearing parts are merely laid into the cap, which is shown at *A* in the illustration, and then the open edge of the cap is spun down firmly on the beveled corner of one of the races. The sheet-metal shell or cap is 3 3/8 inches in diameter and is made of stock from 0.037 to 0.042 inch thick.

In this spinning operation, use is made of two hardened and ground rollers *B*, which are held on a plate *C*, attached to the spindle of an upright drilling machine. Rollers *B* are spaced to suit the diameter of the bearing cap. The lower part of each roller is small enough in diameter to pass the edge of the unassembled cap, the latter being bent outward slightly to facilitate slipping the bearing parts into place. A short distance above the small diameter part of each roller, there is a surface beveled at an angle of 45 degrees, which corresponds with the beveled edge on which the shell is spun. The rollers are mounted in ball bearings.

In the spinning operation, the spindle of the drilling machine is run at about 500 revolutions per minute. Rollers *B* are fed down gradually until they have spun back the edge of the shell as required. The work pieces are held stationary during the operation by clamping the assembly securely on plate *D*. This is done by applying pressure to the C-shaped washer *E* through a foot-treadle and a rod that extends upward through the machine table. Pressure can be instantly applied on the C-washer by this arrangement and as quickly released. Two hundred and fifty units can be assembled in an hour by one operator and a helper who slips the bearing parts into the caps, ready for spinning. C. O. H.



Two Rollers are Employed for Spinning Down the Open Edge of a Sheet-steel Cap

* * *

Monel Metal for Corrosion-Resisting Springs

By WARREN F. MANTHEI

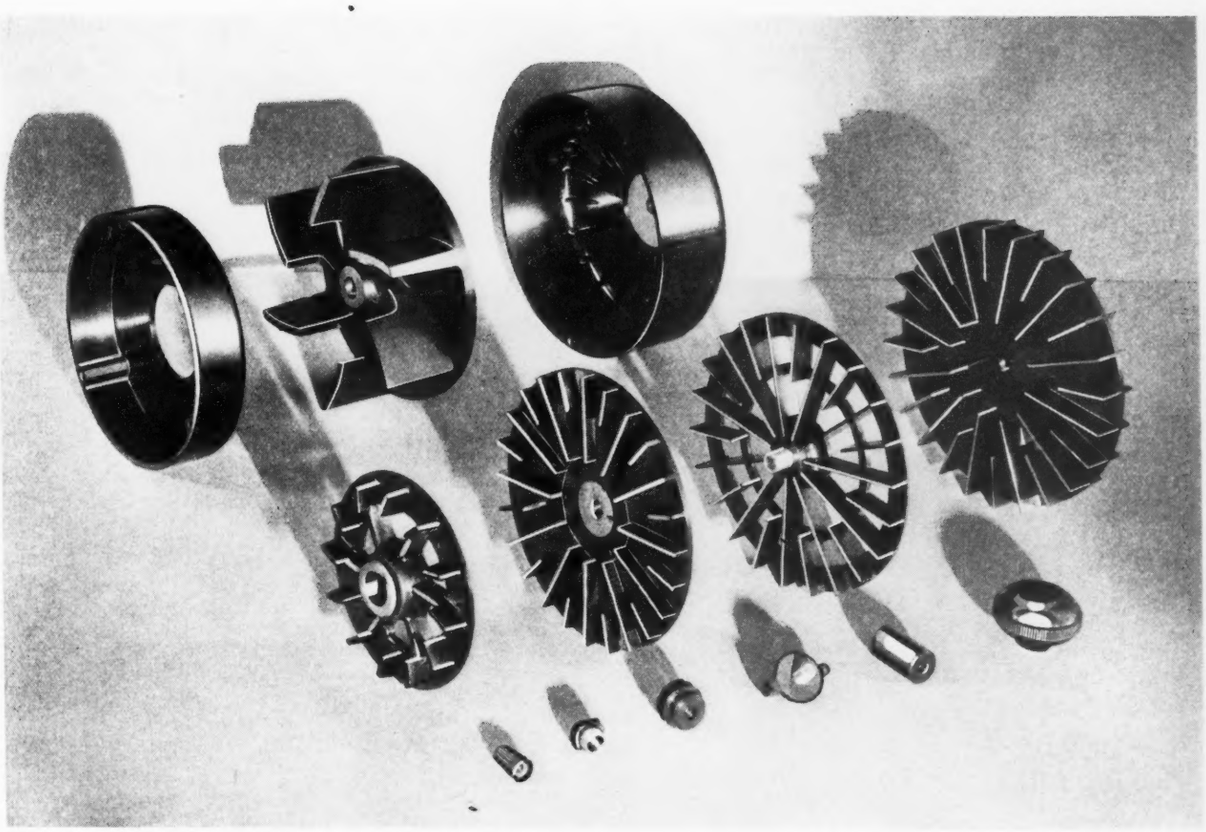
To overcome corrosion in springs, designers have had to resort to spring brass or phosphor-bronze. Spring brass is made from carefully annealed brass strip or rod which is reduced by cold-rolling or wire-drawing to spring temper. Cold-worked brass is subject to unequal internal stresses. Frequently the stress is sufficient to cause "spontaneous breakage" in the course of time. This is called "season cracking," and is probably due in part to surface corrosion as well as to the internal stress. The amount of corrosion necessary to cause cracking is very slight, so that even the slight corrosive action of brass springs is likely to be a serious drawback to their use.

Phosphor-bronze resists corrosion better than brass. It is a very good material for springs used in moist, humid, or salty atmospheres. This material, however, has one serious drawback in that its strength is markedly reduced at moderately elevated temperatures. The weakening begins at the temperature of boiling water.

Springs made of Monel metal have recently proved their ability to operate in hot corrosive atmospheres. Their tensile and torsional strengths and endurance lie between those of phosphor-bronze and steel. Monel metal is also free from the "season cracking" phenomenon found in spring brass. Among other uses, springs made from this material are suitable for surgical instruments that have to be sterilized in hot solutions.

* * *

A good cutting oil for machining nickel-alloy steel consists of a mixture of 8 to 10 per cent of lard oil, 0.8 to 1 per cent flour of sulphur, 10 to 20 per cent kerosene, and the remainder mineral oil to give a viscosity of about 200. It is suitable for soft steels.



How Bakelite Materials are Solving Problems in Machine Design

The Physical Properties of Bakelite Molding Materials Meet the Requirements of a Wide Range of Mechanical Applications, Including Silent-Running Fans and Intricate Machine Parts

By FREEMAN C. DUSTON

MORE than 700 different Bakelite materials with widely varying physical properties are in use today. Most of these materials have been developed to meet specific requirements in the electrical, chemical, mechanical, and decorative fields. Since the introduction of Bakelite resinoid in 1909, there has been a steadily increasing number of applications for this material. The reduction in the price of Bakelite resinoid, or the raw material, from 90 cents per pound in 1916 to about 23 cents per pound, has enormously broadened the field for Bakelite materials.

When we consider the variety of forms in which Bakelite materials are obtainable, as outlined in Table 1, and the range of physical properties of the laminated and molding materials, given in Tables 2 and 3, it is easy to understand why Bakelite resinoid has been termed the "Material of a Thousand Uses." To the uninitiated, the production of the initial Bakelite resinoid from two ill-smelling liquids may seem as impossible or marvelous as some of the works of magic attributed to Aladdin's lamp. To fully appreciate the possibilities of the various Bakelite materials for mechanical applications, it is necessary to know something about their origin, development, and physical properties.

In 1907, Dr. L. H. Baekelend succeeded in producing a new substance called Bakelite resinoid, by the chemical condensation of phenol and formaldehyde. Phenol, commonly called carbolic acid, is a coal tar product marketed in the form of white crystals which readily liquefy when heated or become liquid upon the addition of a slight amount of water. In the production of formaldehyde, wood alcohol is heated and its vapors, mixed with air, are passed over heated copper or platinum, causing partial oxidation. The resultant product, formaldehyde, is a gas; for commercial purposes, it is dissolved in water, the solution being commonly called formalin.

Under certain well defined conditions, the two liquids, phenol and formaldehyde, combine to form

the solid, resin-like substance called Bakelite resinoid, which differs in every way from the liquids from which it is made. This new substance is odorless and tasteless. In its raw or primary state, it is quickly softened by moderate heat and is soluble in certain solvents, such as alcohol or acetone. A very brief exposure to greater heat sets up a chemical reaction and causes it to become so hard so that it cannot again be softened at any temperature. The solvents that served to dissolve the Bakelite resinoid in its primary state are now powerless to affect it. In other words, the continued application of heat serves only to make the material harder. Thus, Bakelite resinoid possesses the unique property of being first softened and then hardened by heat. In this respect it differs from the natural resins that it resembles in some respects.

The name "Bakelite" is a registered trademark of the Bakelite Corporation, 247 Park Ave., New York City. This company supplies Bakelite materials in the various forms given in Table 1. Other companies utilize these materials in the manufacture of finished products which are sold under their own trade names. Micarta, Formica, Dilecto, Phenolite, Spauldite, and Textolite are familiar trademark names for Bakelite laminated materials made by well-known manufacturers.

Table 1. Different Forms in which Bakelite Raw Materials are Manufactured

Form of Raw Bakelite Material	Properties and Uses of Raw Bakelite Material
Bakelite Molding Materials	Plastic materials in powder or sheet form for hot hydraulic press molding. Molded in steel dies under pressure.
Bakelite Varnishes	Coating and impregnating materials for electrical coils, windings, and insulation. Highly dielectric and heat-resisting. Impervious to oils, water, solvents, and most chemicals. Hardened by baking.
Bakelite Enamels	Opaque coatings to protect metal surfaces against corrosion and the action of chemicals. Effective as insulating coverings for metal parts on account of their dielectric strength, hardness, and resistance to heat. Baked, after application, at 250 degrees F.
Bakelite Lacquers	Hard transparent coatings for highly finished metal. Resist solvents, gases, water, and perspiration. Baked, after application, at 275 degrees F. for twenty minutes.
Bakelite Cements	Technical cements for certain special applications. Extremely hard and tenacious; exceptionally resistant to heat, solvents, and most chemicals. Require baking to harden them.
Bakelite—Clear, Translucent, and Colored	Transparent or translucent material, in amber or other colors, used for pipe stems, cigar and cigarette holders, jewelry and other novelty goods. Odorless, tasteless, and non-inflammable. Stronger and more brilliant than amber.
Bakelite Synthetic Resins	Unlike the heat reactive phenol resinoids, these materials are soluble in drying oils. They are adapted to the manufacture of quick-drying varnishes and other finishes of exceptional durability.

Table 2. Properties of Bakelite Laminated Materials

The maximum and minimum values given in this table are the extremes noted in extensive test data covering a wide range of samples, including stock made with paper, linen, and canvas bases with varying degrees of resinoid impregnation.

Property of Material	Minimum	Maximum
Specific Gravity	1.32	1.41
Oil Absorption	Nil	Nil
Water Absorption, Per Cent (24-hour Test)	0.2	3.0
Resistance to Heat (Safe Limit for Constant Temperature), Degrees C.	90	150
Brinell Hardness (Sample Flatwise)	30	40
Coefficient of Expansion (Lengthwise) per Degree C.	0.00002	0.00003
Tensile Strength (Ultimate), Pounds per Square Inch	8,500	24,000
Modulus of Elasticity (From Tensile Test), Pounds per Square Inch	1,000,000	2,500,000
Bending Test (Ultimate Strength), Pounds per Square Inch		
Sample Flatwise	15,000	30,000
Sample Edgewise	15,000	24,000
Compression Test (Ultimate Strength), Pounds per Square Inch		
Sample Flatwise	30,000	43,000
Sample Edgewise	18,000	35,000
Shearing Test (Ultimate Strength), Pounds per Square Inch		
Sample Flatwise	7,000	11,000
Sample Edgewise	8,000	10,000
Dielectric Strength (Volts per Mil Thickness—1 Mil = 0.001 Inch)		
1/8-inch Sample	400	900
1/32-inch Sample	400	1,400
Dielectric Constant	4.5	6
Power Factor (at Radio Frequencies)	1.5	10
Volume Resistivity (Ohms per Centimeter Cube)	10^{10}	10^{13}

Molding Requires Proper Application of Heat and Pressure

The different types of Bakelite molding materials given in Table 3 are formed into finished products in hardened steel molds by the application of heat and pressure. The manufacture of various transparent or semi-transparent articles from the raw Bakelite resinoid is a special art, entirely distinct from that of plastic molding. Such products are turned or otherwise machined from rods or roughly cast blanks of the pure Bakelite transparent material, which is produced by a process involving the application of heat without pressure.

The molding materials are prepared in either powder or sheet form, depending upon the use for which they are intended. They are supplied ready for use, and it is one of the conditions governing the sale of these materials that they be used exactly as supplied, without being adulterated by the addition of other ingredients, and that the molding

technique worked out for each material be strictly observed. This procedure has been adopted to insure maintaining the physical properties specified for the various materials.

When heated in the hot mold, the materials flux, permitting the hydraulic press to force the plastic mass to completely fill the mold. As already mentioned, the heat induces a chemical reaction within the Bakelite resinoid, which hardens it at a rate depending upon the size and shape of the piece and the temperature used. It is very important that the heat be properly regulated and that the application of pressure be correctly timed to suit the molding job.

High-Speed Silent-Running Fans of Bakelite Molded

Bakelite Laminated has for several years been recognized as an important material in machine design, as exemplified by its application to gears and pinions for driving the camshafts of automobile engines. Recent applications of the molded materials indicate that they are likely also to assume an increasingly important place in machine construction. The Bakelite Molded fans shown in the heading illustration, for example, have solved the problem of eliminating or greatly reducing the objectionable noise caused by metal fans of similar design. These fans have been developed by the Black & Decker Mfg. Co., Towson, Md., for use in electric clothes- and dish-washing machines. The fan used on the clothes-washing machine creates a vacuum which causes the necessary agitation of water and clothes. The dish-washing machine has, in addition to the vacuum fan, a fan that circulates the air that cools the motor.

The reduction in the weight of these parts effected by the use of Bakelite Molded is an advantage, of course, but the principal reason for using this material is to obtain more silent-running fans. A metal fan produces a metallic ringing sound that is trans-

Table 3. Physical Properties of Bakelite Molding Materials in General Use*

Class of Service for which Bakelite Molding Material is Suited	Tensile Strength, Pounds per Sq. In.	Compressive Strength, Pounds per Sq. In.	Hardness, Brinell (500-kilogram Load)	Dielectric Strength, Volts per Mil (1 Mil = 0.001 In.)	Water Absorption (Test Piece 4 in. Diam. by 1/8 in. Thick)		Coefficient of Expansion, per Deg. C., in Inches per Inch	Weight per Cubic Inch, Ounces
					Time Immersed, Hours	Absorption, Per Cent		
General-purpose Molding Materials in Wide Choice of Colors (Group with Wood-flour Filler)	6000 to 11,000	25,000 to 36,000	34 to 40	300 to 500	100	0.60 to 0.75	0.00003	0.78
Heat-resistant Materials (Group with Asbestos Filler) Standard Colors, Brown and Black	7000 to 10,000	18,000 to 36,000	45	150 to 350	100	0.2	0.00002	1.1
Shock-resistant Materials for Parts Subjected to Rough Usage or Mechanical Stresses (Small Pieces of Fabric Processed with Bakelite Resinoid) Standard Colors, Brown and Black	7000 to 8500	28,000 to 32,000	40	350 to 500	144	1.8 to 2.4	0.000045	0.79 to 0.82
Molding Sheet that can be Softened on Hot Plate to Permit Cutting and Forming Preliminary to Molding	Molding sheet is made in one size, approximately 18 by 40 inches by 3/16 inch. It is hard and brittle when cold, but can be softened in a few minutes on a hot plate, so that it can easily be cut, shaped, or manipulated by hand into suitable forms for charging molds. It is intended primarily for use in overflow or "flash" molds, or for pieces of complicated design where an unusually free-flowing material is desired. The physical properties are about the same as those of wood-flour molding powder, and it requires the same molding treatment.							
Tough Bakelite-impregnated Paper and Fabric Materials for Washers, Disks, and Small Flat Pieces of Uniform Thickness	Blotting paper or other fibrous paper stock impregnated with Bakelite varnish often proves a very satisfactory molding material. Materials of this kind insure a tougher product than molding powder but have no "flowing" quality. Thus, pieces punched from this material must be the full size and shape of the mold, as the molding operation reduces the thickness only. One or several superimposed blanks can be used to give the finished thickness desired. Molding powder will bond tenaciously with this sheet material, and, therefore, a combination of the two materials is often advantageous.							
Special Molding Materials for Parts Subjected to Unusual Conditions in Service	The special molding material XM-264 offers an exceptionally high resistance to water. The XM-53 material was developed primarily for water-meter disks and is suitable for molded parts in constant contact with boiling water. CM-367 is a black molding material used for surfacing molded articles to secure greater depth of color and brilliance of finish. It is best adapted to flat pieces.							

*The maximum and minimum values given here represent the range covered by the several different materials made for each class of service.

mitted by the air stream and is especially objectionable in household appliances. These fans operate at very high speeds, being driven by universal motors running at speeds of 10,000 revolutions per minute. The fans illustrated range from about 3 1/2 to 5 1/2 inches in diameter and are molded accurately to size. In some cases, threaded metal bushings or hubs are molded in place.

Bakelite Molded Base for Small Machine

In Fig. 1 is shown a Bakelite Molded sewing machine tray, or base, recently developed by the Union Special Machine Co., Chicago, Ill. This base is approximately 17 by 12 by 3 1/2 inches in size, and has several threaded brass bushings molded in place. Although of ample strength, it is lighter than the wood base previously employed. Mechanical noises of the machine are not amplified by this type of base, as the material is a non-conductor of sound.

The generously rounded corners of the molded base permit the work or cloth to pass over it smoothly, thus relieving the feeding mechanism of the machine from strains. The finish is permanent, and continued use only serves to improve it, as there is no varnish or other coating to wear off. Oil and grease can be readily wiped off, and washing will not harm the finish.

Molded Machine Parts of Intricate Design

Molded Bakelite parts, such as shown in the lower part of Fig. 1, are important elements of the mechanical assembly attached to or assembled within the molded base. These parts are light in weight, yet they have sufficient strength to meet all requirements. From the illustration, it is obvious that it would be difficult to form some of the parts from a single piece of sheet metal. The metal bushings with tapped or plain bearing holes, which are molded into the parts, are accurately spaced and permit assembling to be done quickly and accurately.

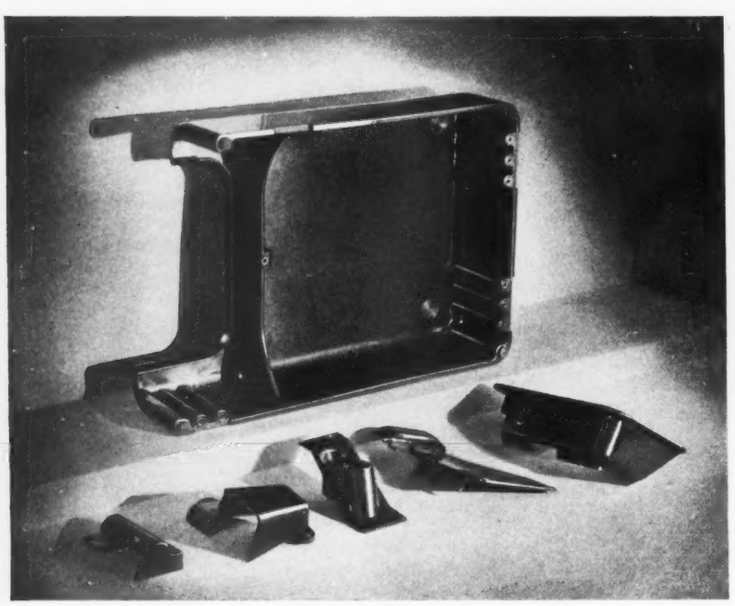


Fig. 1. Bakelite Molded Base and Parts of Sewing Machine

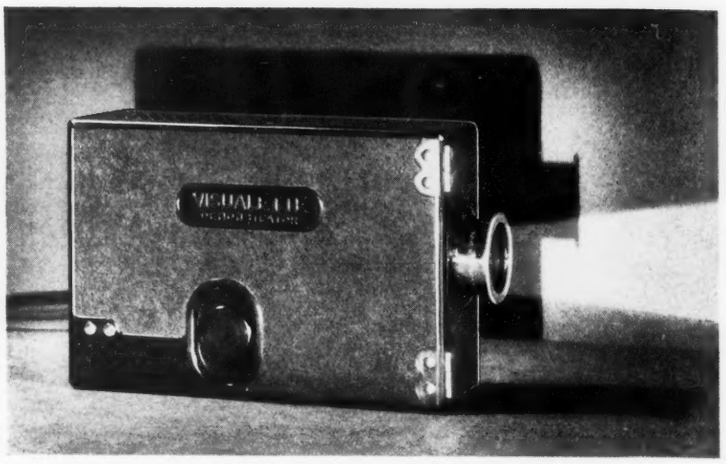


Fig. 2. Slide Picture Projector Made of Bakelite Molded

Advantages of Molded Machine Parts

The advantages obtained by making machine parts of Bakelite Molded may be summarized as follows: (1) Parts are molded accurately to required dimensions and come from the mold with a lustrous, pebbled, or cross-hatch finish, as determined by the finish given the molds; (2) inserts of any metal can be molded in the exact positions desired; (3) the molded parts have great dielectric strength and are mechanically strong; (4) they withstand high temperatures; (5) they can be machined and polished; (6) they are non-hygroscopic; (7) they are impervious to steam, oils, and solvents; (8) being chemically inert, they will not deteriorate with age; (9) they assist in obtaining silent operation of contacting or running parts.

Filling materials are used with the Bakelite resinoid for the purpose of obtaining molded parts having the distinctive properties of the fillers in a greater or less degree. Wood flour, asbestos, fabric, and paper are fillers commonly used. In all cases, the Bakelite resinoid, or original substance, remains unchanged. The use of graphite as a filler gives the molded part self-lubricating qualities, while the use of asbestos gives the molded part better heat-resisting qualities.

Shock-Resistant Molded Parts for Oil-Well Equipment

The shoe guide and the back pressure valve shown in Fig. 3 are recent applications of Bakelite Molded in the oil-well

equipment field. Shock-resistant Bakelite Molded was selected for these parts by the Larkin Packer Co., St. Louis, Mo., to overcome certain difficulties experienced with other materials. These parts are molded from fabric base material. Although this material weighs only 0.78 ounce per cubic inch, it has a tensile strength of more than 7000 pounds per square inch, and a compressive strength of over 28,000 pounds per square inch. These parts have been used very successfully for oil-well operations in a particular locality where similar parts of other materials, including cast iron, failed to meet requirements.

Bakelite Molded is one of the most versatile materials available from the viewpoint of appearance or decorative effect. In fact, appearance alone has been the determining factor in the selection of Bakelite materials for hundreds of products in everyday use. In one form, Bakelite transparent material is made into such products as pipe stems and parasol handles that have every appearance of amber. It may also be made in a form having the transparency of clear glass or with any of the tints and colors used in glassware.

Fig. 3. Oil-well Shoe Guide and Back Pressure Valve of Bakelite Molded Shock-resistant Material

Bakelite Molded parts can be made in any solid color desired or in a combination of any colors and markings. The colors are permanent and do not become dull. Bakelite Laminated can be colored to resemble marble, onyx, finely colored and grained woods, cornelian, jade, and many other natural products.

A highly lustrous, pebbled, grained, or crosshatch finish can be given to Bakelite Molded products. Two or more different types of finish can be given to one part to obtain the desired decorative effect. For example, the Bakelite case of the slide-film projector shown in Fig. 2 has the panel surface pebbled to resemble leather, while the corners and edges are given a high luster, comparable with that of polished metal. Thus a molded piece can have the appearance of being made of two different materials. The insertion of metal parts in molded pieces of this kind saves assembling and fitting operations.

Considering the extent to which Bakelite materials have already been applied in the mechanical field, and the rapid progress being made in the development of equipment for its fabrication, it is evident that these products are destined to have an increasingly important place among the materials utilized by the designer of machines and mechanical equipment.

* * *

Preventing Distortion in Grinding Long Lengths of Thin-Walled Tubing

In grinding the outer surfaces of long lengths of thin-walled tubing, particular attention should be given to uniform annealing previous to grinding. According to *Grits and Grinds*, published by the Norton Co., Worcester, Mass., unless the annealing is uniform, the removal of the outer layer of stock may cause the tube to change shape. This would become apparent by a pronounced intermittent grinding action. If a tube is perfectly annealed, it is inert as far as internal strains are concerned; if upon grinding, there is still a tendency for the work to become deformed, the difficulty is probably due to excessive grinding heat.

Flooding the work with more grinding compound or changing to a softer and freer cutting wheel may correct the condition, but if these steps do not help, other means of keeping a uniform temperature should be used. Filling the tubes with water or wet sawdust has been found effective. The filling absorbs the heat before it has a chance to distort the wall of the tube. The time required for the added operation of filling and emptying the tubes will be more than offset by faster grinding and less spoiled work. It is, of course, necessary to provide caps or plugs on the ends of the tube to prevent loss of the filling.

Distortion also often results from a poor selection of the grinding wheel. A good general rule is to try the same wheel that would be used for solid work of the same material. Actual grinding will then indicate whether or not a different wheel should be used.

* * *

Patents kept dormant by the inventor hinder rather than help the progress of industry.

Selecting the Right Cutting Tools in a Modern Machine Shop

Cutting Capacities of Different Materials Have Been Determined by Observation of Tools in Actual Production and by Carefully Conducted Tests—First of Two Articles

By J. M. HIGHDUCHECK
Assistant Superintendent
Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.

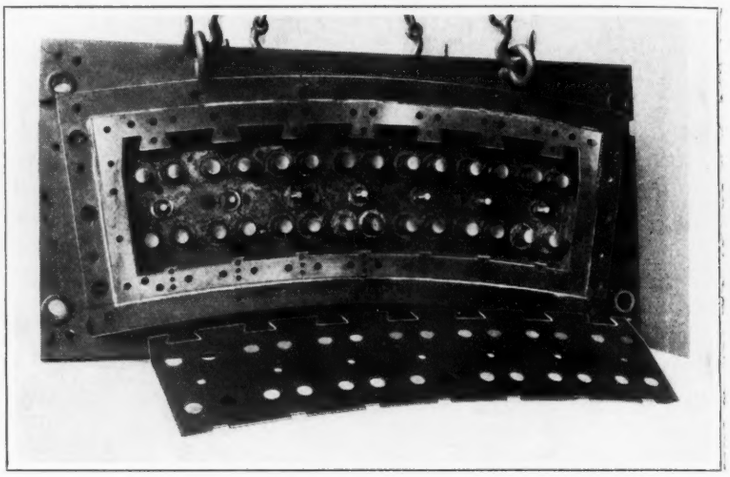


Fig. 1. Low-carbon, High-carbon, and High-speed Steels are Used in this 8400-pound Blanking and Piercing Die

CONSIDERABLE difference of opinion exists among tool engineers regarding the scope and comparative values of the various metal-cutting materials now in use, including carbon and high-speed steel, Stellite, and the more recently developed tungsten and tantalum carbides. It is the object of this article to describe the principal characteristics and uses of these different cutting materials, as determined by practical applications in a large manufacturing plant.

The newer cutting materials supplement, but do not replace the older ones. The introduction of high-speed steel has not lessened the demand for carbon steel, as many seem to believe. Actually, more carbon steel is used today than when high-speed steel appeared on the market. When cobalt high-speed steel was brought out, it was the general belief that it would replace ordinary high-speed steel. This, again, proved a mistaken idea, because cobalt high-speed steel, like Stellite and the new carbide alloys, created a place for itself without eliminating the older cutting materials. It is the writer's opinion that the use of carbon and high-speed steel will continue to increase along with the new high-speed cutting materials.

In order to determine the relative durability and cutting capacities of some of the metal-cutting materials now in use, a series of tests was made. The cutting materials selected for these tests were tungsten high-speed steel, cobalt tungsten high-speed steel, Stellite, tantalum carbide, and tungsten carbide. The tool form used in all the tests was the same. Four brands of each of the grades were selected, with the exception of Stellite.

The tools were ground at the beginning of each test and were run until they burned, the tip came off, or a piece of the cutting edge broke away. Various speeds were used, but a feed of 1/16 inch and a cut 1/4 inch deep were constantly maintained throughout the tests. The material on which the test cuts were taken was S A E 1035 heat-treated steel. The performance records of the various brands and grades of cutting materials are given in the accompanying table. The cutting time, in minutes, and the number of cubic inches of material removed in the time given are entered in this table for convenience in making comparisons.

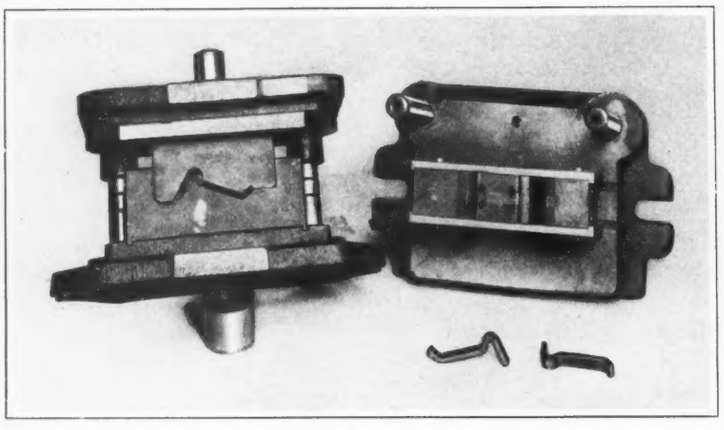


Fig. 2. Forming Die Made of High-carbon Tool Steel

Applications of Carbon Steel Tools

Before considering the performance of the newer cutting materials, we can properly refer to the practical applications of carbon steel cutting tools. If the

cutting speed is too high when ordinary carbon steel is used for cutting metals such as cast iron or steel, the excessive heat generated by the friction at the cutting edge of the tool will cause the steel to lose, to some extent at least, the hardness obtained as a result of heat-treatment. Consequently, the cutting edge will be worn away and the tool will no longer cut effectively.

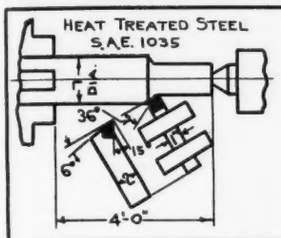
Plain carbon steel, composed of from 1.10 to 1.20 per cent carbon and a maximum of 0.30 per cent manganese, 0.02 per cent phosphorus, 0.02 per cent sulphur, and 0.30 per cent silicon, is well adapted for use in tools such as the following: (1) Lathe centers and arbors; (2) mandrels; (3) counterbore pilots; (4) ring gages; (5) plug gages; (6) drill bushings; (7) gage pieces on milling fixtures; (8) collets (working ends only); (9) scrapers; (10) V-blocks; (11) cold punches; (12) punches for soft material; (13) knife blades; and (14) screwdrivers.

The tools from (1) to (10), inclusive, should have a scleroscope hardness of 80 to 90, and those from (11) to (14) should have a hardness of 70 to 80. Of course, carbon steels vary somewhat. Grades having a carbon range of from 1.00 to 1.10 are generally considered very good water hardening steels. These steels are capable of withstanding a tremendous amount of abuse and are generally used for tools requiring a combination of hardness and toughness, especially when hardness is the important consideration. This grade of carbon steel is recommended for blanking, piercing, forming, and drawing dies.

Characteristics and Applications of High-Speed Steel

The majority of high-speed steel cutting tools used at present are made from high-speed steel containing 0.70 per cent carbon, 4 per cent chromium, 1 per cent vanadium and 18 per cent tungsten. This kind of steel is the easiest to harden. It is generally referred to as a high-tungsten, low-vanadium steel.

Cutting tools made from this steel give satisfactory service when used under normal conditions, regardless of the type of material being machined. This is because this steel maintains a cutting edge when heated to temperatures that would ruin plain carbon steel. A few of the purposes for which this steel is used are: (1) Cutting tools; (2) milling cutters; (3) gear hobs; (4) counterbores; (5) hardened die parts that can be readily ground; (6) punches; (7) end-mills; (8) drills; and (9) reamers. Tools of this kind have a scleroscope hardness of 80 to 90.



TEST TO DETERMINE THE DURABILITY OF DIFFERENT CUTTING TOOL MATERIALS

THE TOOLS USED IN THIS TEST WERE WESTINGHOUSE TYPE #40. CROSS SECTION OF THE SHANK 1" × 2". THE TOOLS WERE GROUND WITH A FRONT CLEARANCE OF 6°, SIDE SLOPE 4°, BACK SLOPE 15° AND A NOSE RADIUS 1/8". 4 BRANDS OF EACH GRADE (EXCEPT STELLITE) WERE TESTED. 3 TOOLS OF EACH BRAND WERE RUN UNTIL THEY EITHER BURNED, OR A PIECE OF THE CUTTING EDGE BROKE. NOTE—ALL TOOLS WERE TIPPED. SIZE OF TIP 1/2" × 5/8" × 1".

MACHINING HEAT TREATED STEEL S.A.E. 1035

		25 Ft. Per Min.		50 Ft. Per Min.		75 Ft. Per Min.		100 Ft. Per Min.		150 Ft. Per Min.		300 Ft. Per Min.	
		Cutting Time in Minutes	Cubic Inches Removed	Cutting Time in Minutes	Cubic Inches Removed	Cutting Time in Minutes	Cubic Inches Removed	Cutting Time in Minutes	Cubic Inches Removed	Cutting Time in Minutes	Cubic Inches Removed	Cutting Time in Minutes	Cubic Inches Removed
Tungsten High Speed	Brand #1	497.1	2311.5	36.0	334.8	9.7	135.3	2.6	48.3	No Test Made On These Speeds			
	Brand #2	501.0	2329.6	38.7	359.9	12.9	179.9	1.9	35.3				
	Brand #3	511.0	2376.1	29.9	278.0	13.1	182.7	2.0	37.2				
	Brand #4	463.8	2156.6	33.0	306.9	14.3	199.4	1.4	26.0				
Average Performance		493.2	2293.4	34.4	319.9	12.5	174.3	1.9	36.7				
Cobalt Tungsten High Speed	Brand #1	1102.1	5124.7	66.0	613.8	42.6	594.2	9.7	180.4	No Test Made On These Speeds			
	Brand #2	989.5	4601.1	81.3	756.0	28.7	400.3	4.3	79.9				
	Brand #3	1003.9	4668.1	66.3	616.5	20.8	290.1	5.2	96.7				
	Brand #4	1179.0	5482.3	71.0	660.3	29.1	405.9	5.7	106.0				
Average Performance		1068.6	4969.0	71.1	661.6	30.3	422.6	6.2	115.7				
Stellite No. 3		No Test Made On These Speeds				312.5	4359.3	189.2	3519.1	12.1	337.5	.310	17.3
Average Performance						103.1	1453.1	63.0	1173.0	4.0	112.5	.103	5.7
Tantalum Carbide	Brand #1	* 3 Tools Tested. 1 Tool Failed, Defective Tip Brazing						580.0	10788.0	391.0	10908.9	140.1	7817.5
	Brand #2	+ 3 Tools Tested. 2 Tools Failed, Defective Tip Brazing						+ 151.0	2808.6	+ 91.5	2552.8	• 11.2	624.9
	Brand #3	• 3 Tools Tested 3 Tools Failed, Defective Tip Brazing						* 400.5	7449.3	+ 110.2	3074.5	+ 38.5	2148.3
	Brand #4							610.0	11346.0	• 95.1	2653.2	166.5	9290.7
Average Performance								435.3	8097.9	171.9	4797.3	89.0	4970.3

CAST IRON

Cemented Tungsten Carbide	Brand #1	No Test Made On These Speeds								1080.0	30132.0	560.0	31248.0
	Brand #2									991.0	27648.9	611.0	34093.8
	Brand #3									1105.5	30843.4	641.0	35767.8
	Brand #4									1320.2	36833.5	710.5	39645.9
Average Performance										1124.1	31364.4	630.6	35186.3

MACHINING CAST IRON WITH CEMENTED TUNGSTEN CARBIDE AT 150 & 300 SURFACE FEET PER MINUTE

High-speed steels are of great importance, and many types are on the market. The property of "red hardness," or the ability of the tool to maintain a cutting edge when heated to a temperature that would destroy the cutting qualities of carbon steel, is the prime characteristic of this material. In general, this is a very economical material to use. It is, however, outclassed by cutting steels such as cobalt steel, sometimes called super-high-speed steel. A study of the various cutting steels has proved that, to obtain the most economical results in cutting metals, it is necessary to know the characteristics of all the cutting steels and apply each one in the manner best adapted to bring out its advantages.

A good example of the application of low- and high-carbon steel and high-speed steel is the blanking die shown in Fig. 1. Each of the three different cutting steels used in this die fulfills a particular requirement. The die weighs 8400 pounds. About 600 pounds of the total weight is high-speed steel, 200 pounds high-carbon steel, and the balance low-carbon steel.

Advantages of Cobalt Steel

During the last three or four years, the demand for cobalt steel has grown by leaps and bounds. Many manufacturers are using large quantities of cobalt steel in preference to any other cutting material. Good grades of cobalt steel are particularly adapted for heavy cutting.

The advantages of cobalt high-speed steel are due to the high breakdown temperature at the point of the tool. The performance of the tungsten high-speed and cobalt tungsten high-speed steel at speeds of 25, 50, 75, and 100 surface feet per minute is shown in the table.

It is recommended that the tools to be tipped with cobalt steel are those used for heavy cutting purposes. This does not mean that cobalt steels are not practicable in the solid forged form, as solid forged tools of this material can be used to advantage in some cases. However, extreme care must be exercised in forging cobalt steel, and the forging must be done much more slowly than when forging high-speed steel. After such tools have been forged, care must be taken to grind off 1/32 to 1/16 inch after the hardening operation, in order to remove the soft skin or outer layer produced in hardening. The scleroscope hardness should be 80 to 90.

General Application of the Different Cutting Materials

In the Westinghouse shop, tools of different cutting materials are made up in standard sets or groups, according to the shapes indicated on a "standards" sheet. The shapes of the tools are classified in three groups. One group includes solid high-speed steel tools of the types generally used for threading, parting, facing, and copper-turning. A second group includes tools generally referred to as finishing, facing, radius, and forming tools.

These tools are not made from solid high-speed steel, but have low-carbon steel shanks and are tipped with high-speed steel. The shank material is a low-carbon steel composed of 0.50 to 0.60 per cent carbon, 0.60 to 0.90 per cent manganese, 0.04 per cent phosphorus, 0.20 per cent sulphur, and 0.20 per cent silicon. This grade of steel is highly recommended for tool shanks to which tips of high-speed steel, cobalt, tungsten and tantalum carbide can be brazed. The third group consists of tools for taking heavy cuts, having carbon steel shanks tipped with cobalt steel.

The application of tungsten- and tantalum-carbide tools will be described and illustrated in the second article, to be published in a later number of MACHINERY.

A Demonstration of the Reliability of Arc Welding

Perhaps there is no more convincing demonstration of the reliability of arc welding than its adoption by the Ordnance Department for use in the construction of gun carriages. In the paper awarded the second prize of $3500 in the recent Lincoln arc-welding competition, Major G. M. Barnes of the Watertown Arsenal describes how arc welding has been applied by the Ordnance Department in gun-carriage construction.

Until recently, there was a strict ruling against any welding whatsoever in connection with gun and gun-carriage work. It was believed that welding was not a safe method of construction for such ordnance material as gun carriages, which are called upon to resist sudden large impact forces.

It is difficult for the ordinary engineer to appreciate the dependability that must be built into a gun carriage. The requirements for strength are far beyond those that would be satisfactory for most commercial equipment. Gun carriages must function under the most adverse conditions in the field, where repairs are exceedingly difficult, if not impossible, to make. If a piece of artillery fails to function for a few minutes, it may lose its value forever. Commercial machines, when they fail temporarily, can be repaired and put back to work.

The importance of reliability in ordnance equipment has been emphasized merely to bring out the point that in adopting electric arc welding as a means of construction, a stamp of approval has been placed on this method for work where dependability is one of the main factors. In addition to the strength obtained, a saving in weight of as much as 37 per cent has resulted from the use of the welding process in the construction of ordnance.

Reconditioning Worn Chucks

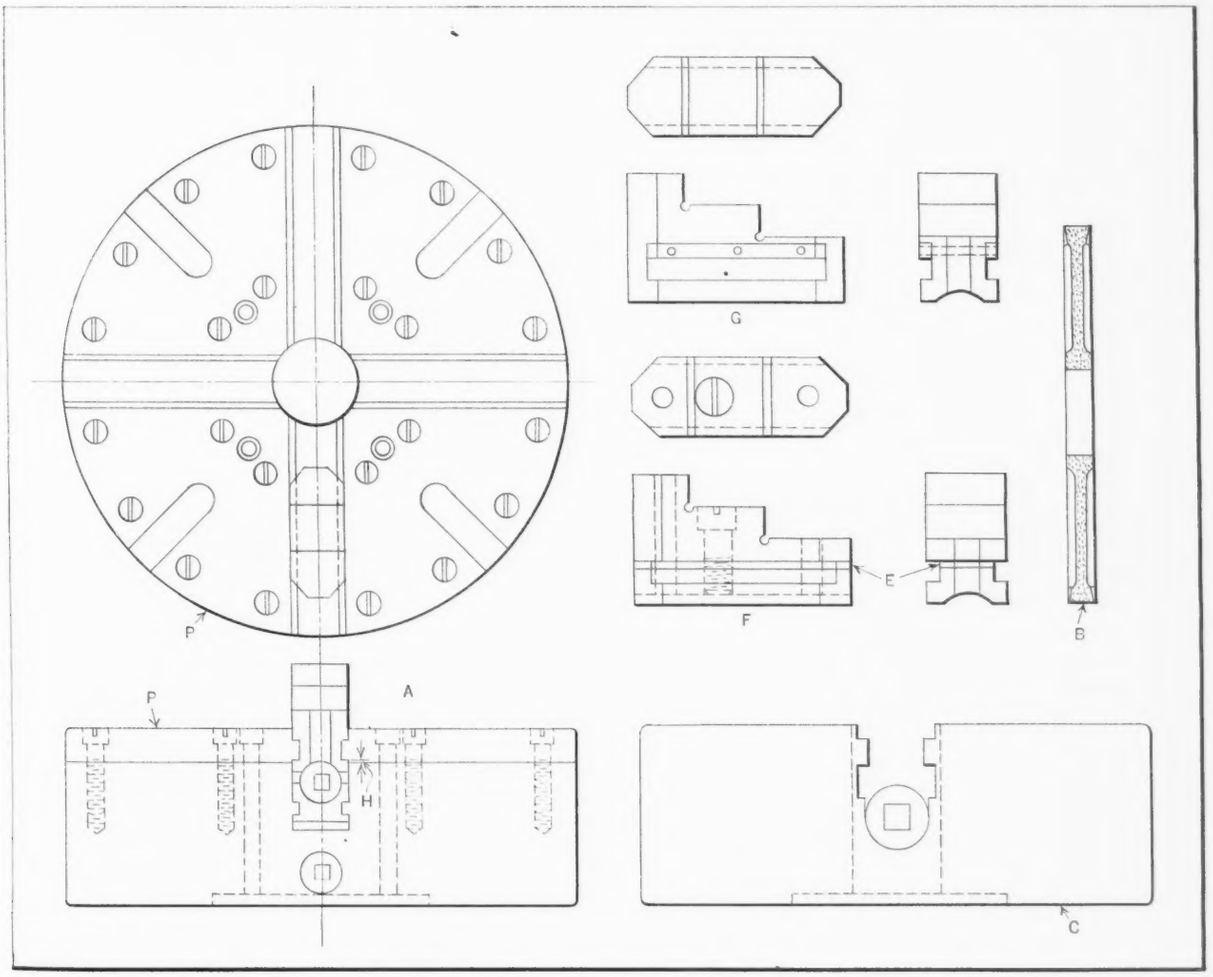
By WILLIAM C. BETZ

CHUCKS with jaws that have worn loose on their bearings through long service can be repaired in a number of ways, three of which are described in this article. The 12-inch scroll combination chuck shown at *A* in the accompanying illustration was worn so badly that the jaws tipped up at the front about 1/16 inch when gripping a piece of work near the inner edge. As a new chuck of this type would cost about $75, the expenditure of $30, or 40 per cent of the price of a new chuck, in making repairs seemed a good investment, provided the chuck would then be as good as new.

After taking the chuck apart, the shell was gripped and trued up in a lathe chuck, and the face turned off to a little below the lower edge of the jaw slide, or an amount *H* as shown. Next, four pieces *P* of machine steel were surface-ground to the same thickness as the amount turned off the chuck face. These pieces were screwed and doweled to the chuck body, and turned flush with the outside.

The jaw-slide slots were next ground on a surface grinder to straighten the surfaces and bring them to a given width and distance from the bottom, with the sides parallel. This was accomplished through the use of a grinding wheel shaped as shown at *B*, which allowed both sides of the slot to be ground without changing wheels. For this operation, the jaws were held in a vise bolted to the platen of the grinder, the stationary jaw having been set parallel to the ways of the machine. The jaw slides in the chuck shell were next refinished as follows: The shell was set up on the dividing plate of a vertical milling machine, and the slides were milled with a T-slot cutter and an end-mill to give a snug fit for the jaws.

Smaller chucks, which could be replaced with new ones for less than it would cost to repair them by the methods described, can be put in serviceable condition by less expensive methods. One method is to grind the slots in the jaws as shown at *G*, and



Methods Used in Repairing Chucks with Jaws that have Become Loose through Wear

rivet on pieces of ground steel. Grinding the jaws in this manner cuts through the carburized surface and facilitates drilling the rivet holes. Chuck bodies such as shown at *C* can be milled, and the jaws can be fitted to the milled grooves the same as for the chuck shown at *A*.

Another way to repair a small chuck is to cut the jaws in two with a rubber bond wheel and insert a piece of ground steel *E*, as shown in the view at *F*. This inserted piece brings the slot width to the proper size, so that it is a good fit for the body slides after they have been touched up on a milling machine. By cutting these jaws in the hardened condition, no annealing is required to permit drilling the screw- and dowel-holes, as these holes will be in the decarburized zone. The upper half, however, will require annealing in order to permit drilling and counterboring through the casehardened surface at the top. These halves of the jaws should be rehardened and the faces should be ground smooth.

The methods illustrated at *F* and *G* are inexpensive to use, and while satisfactory for small low-priced chucks, they can only be employed once or twice on the same chuck, as touching up the slides in the chuck body tends to carry the jaw away from the screw centers. This brings the jaw slightly out of mesh with the screw threads. However, this may be done once or twice without seriously affecting the operation of the chuck. A 12-inch chuck like the one shown at *A*, which was repaired over three years ago and has been in use on rough machine work since, shows no appreciable wear at the present time. The cost of repairing this chuck, including overhead, was less than half the cost of a new chuck.

Increasing the Density of Steel Forgings to Improve Machineability and Durability*

Improved machineability and durability of parts made from steel forgings are obtained by increasing the density of the forging. This increased density is brought about by greater compression of the steel in the forging process. In machining a number of nickel-steel gears, it was noticed that the drilled and broached holes of some of them showed a very smooth finish, while others were torn and rough, regardless of the fact that the same forging and heat-treating methods were applied to the entire lot.

After studying the forgings, it was found that some had rounded corners, while others had square ones, and that the smoothest holes were produced in the forgings having square corners. The rounded corners were due to the failure of the metal to fill the die completely. This was corrected by increasing the forging temperature to 2150 degrees F., thus permitting a more satisfactory flow of metal into the die. In addition to this, the dies were altered so that the entire compression would come in the forging rather than partly in the flash. After these changes were made, a marked improvement in machineability was observed.

Coarsening the structure of the bars before heating for forging also improves the ductility of the fibers and thus promotes the flow of metal in the dies. For example, a steel bar containing 0.5 per cent carbon and 1 per cent chromium, with a medium-fine structure, was selected. Forgings were made from one end of this bar and the remainder was cut up to make similar forgings. The latter pieces, however, were annealed by furnace-cooling, after soaking for one hour at 1650 degrees F. Half of these pieces were forged, and the other half reannealed by soaking at 1750 degrees F. and then forged.

Upon a microscopic examination of the forgings, it was found that the density of the last two lots was increased over that of the initial lot, and that the density increased with the number of annealing operations. This experiment is significant in that it suggests that the coarse structure obtained by annealing has more ductile fibers and hence is better adapted for forging.

Corrections in forging practice, as outlined, have resulted in an improvement in machineability of from 50 to 400 per cent, depending upon the operation. Speeds and feeds have been increased from 11 to 60 per cent, and tool life has been increased in like proportion. In addition to this, it might be added that the over-all tool cost per job in one plant has been reduced from 84 to 44 cents within the last year by following the forging practice outlined.

Dynamometer tests have been run to determine the difference in durability between hardened gears made from the old and the new types of forgings. Examination of these gears, after they finally broke down, disclosed that the pits on gears made from the new type of forgings were considerably smaller than those made from the older type. The gears made from the new type forgings broke down in about 127 hours, while those made from the older type lasted about 75 hours.

Summarizing, it has been found possible, by following the methods indicated, to produce more uniform forgings, thereby obtaining improved machineability. This permits the use of greater feeds and speeds, increases tool life, and reduces tool costs. These improved results have been obtained irrespective of the steel used in the forgings.

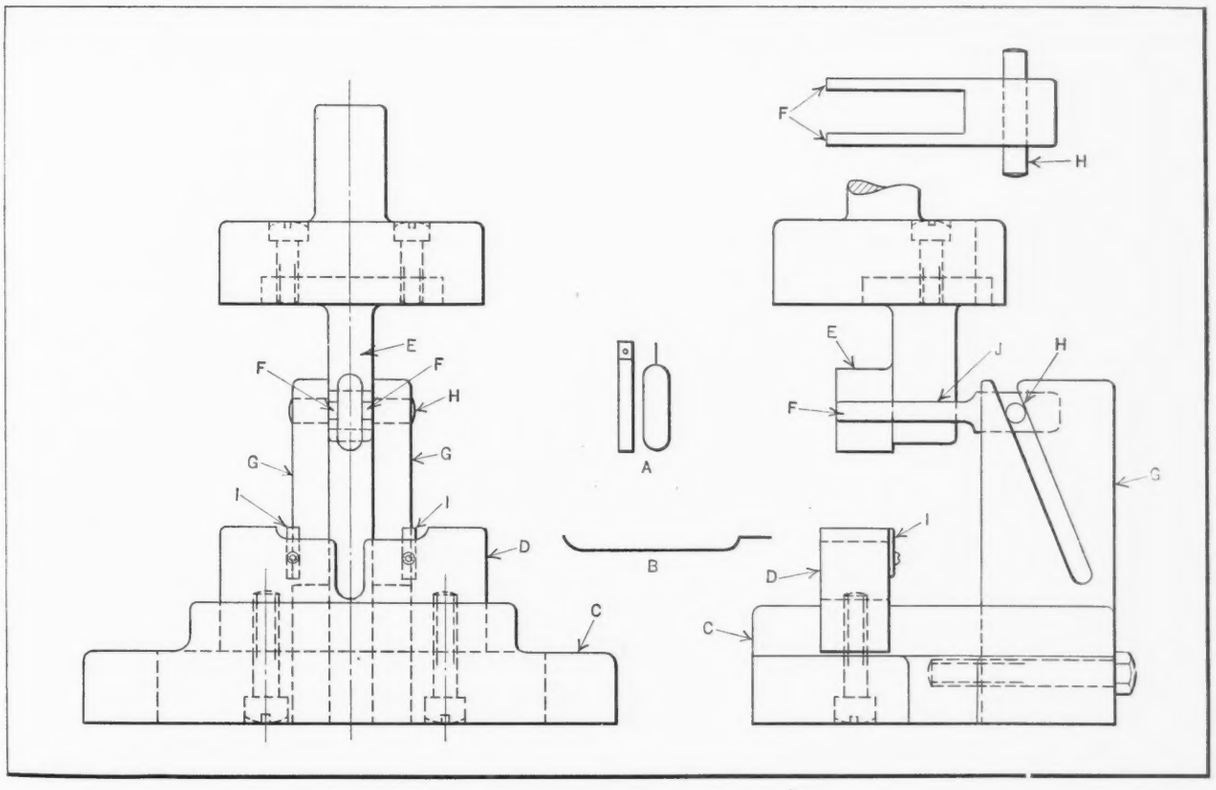
*Abstract of a paper by Fred W. Cederleaf and W. E. Sanders, Muncie, Ind., presented at the semi-annual meeting of the American Society of Mechanical Engineers.

Effective Work Ejector for Forming Die

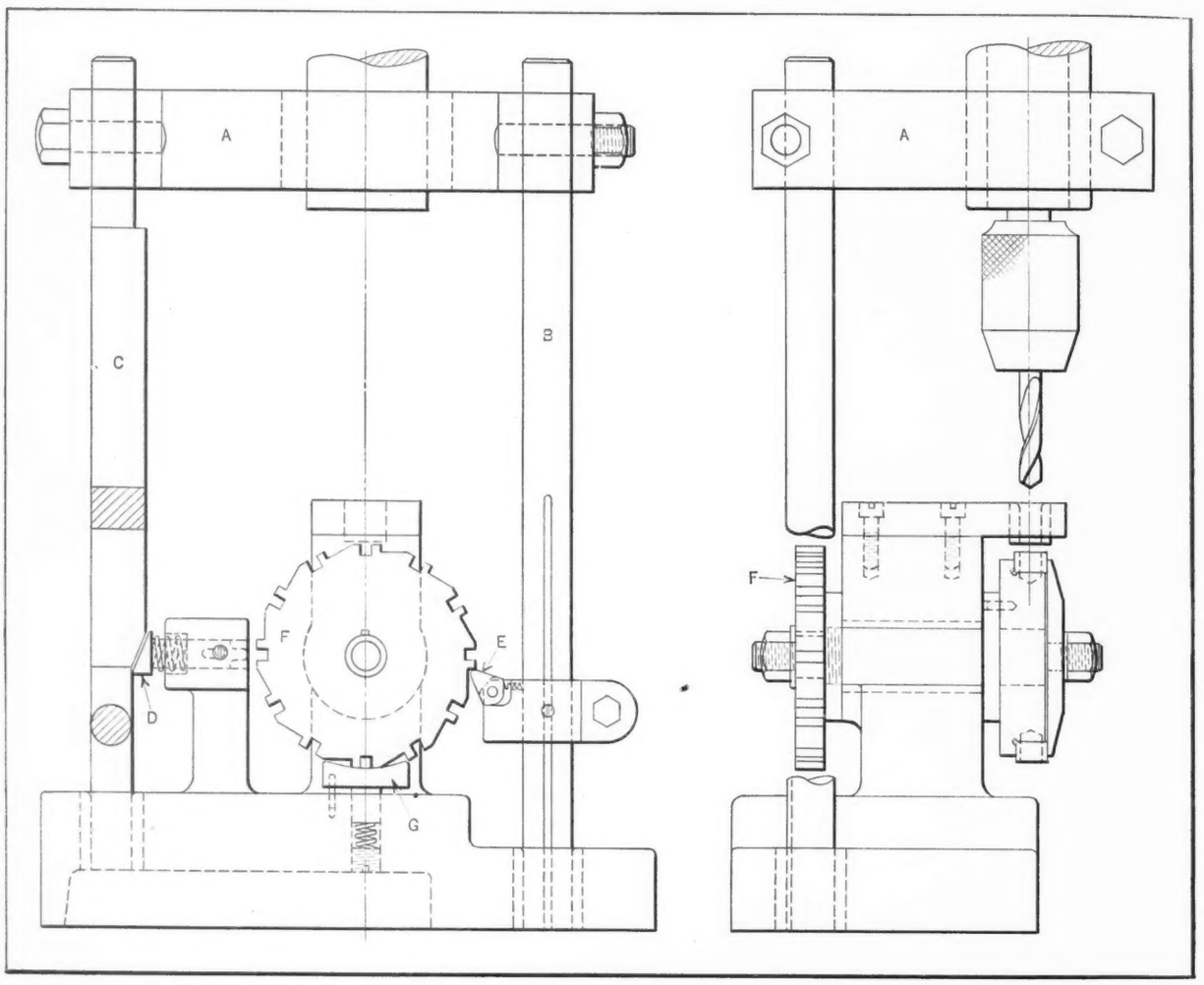
By H. H. KNABE, Madison, Wis.

The ejecting device of the forming die shown in the accompanying illustration automatically pushes the formed piece *A* from the punch *E* on the upward stroke of the press. Thus no time is required for unloading the work and danger of injury to the operator's hand is eliminated. The piece to be formed is cut off, pierced, and formed to the shape shown at *B* in another die previous to being formed to the shape shown at *A*. The material is 16-gage soft cold-rolled steel. The piece *B* is placed in the locating nest of the die *D* against stops *I*.

As punch *E* descends, the action of pin *H* in the angular slots in plates *G* causes the fingers *F* to be pulled back so that they clear the work, which is formed about the punch. As the punch ascends, fingers *F* are pushed out through the action of pin *H* in the angular slots, causing the work to be pushed from the punch. Fingers *F* are kept in proper alignment by the slots *J* in punch *E*. This



Forming Die Equipped with Work Ejector Actuated by Pin and Angular Slot Arrangement



Drill Jig which is Automatically Indexed and Locked with the Movements of the Drilling Machine Spindle

ejecting arrangement has proved very satisfactory, more than 200,000 pieces having been made with a die equipped as shown.

A Drill Jig that Indexes Automatically

By WILLIAM C. BETZ, Master Mechanic
The Fafnir Bearing Co., New Britain, Conn.

An automatic indexing drill jig of simple design for drilling holes in circular parts is shown in the illustration. The indexing mechanism operates automatically with the up and down movements of the drilling machine spindle. Bracket *A*, which is fastened to the spindle, actuates rods *B* and *C*, which, in turn, operate the indexing and locking devices, respectively.

When the drilling machine spindle is fed downward, before the drill or other tool touches the work the cam surface of plunger *C* comes in contact with the beveled head of locking pin *D* and pushes this pin forward, so that the tongue on its front end enters a slot in index-plate *F*. Thus the jig is locked securely for the drilling operation.

When the drilling machine spindle is raised, pawl *E* engages the indexing slots in disk *F* and rotates the disk, together with the jig, enough to bring the next locking slot opposite pin *D*. Indexing of the jig can be closely regulated by positioning the bracket of pawl *E* accurately on rod *B*. The spring-actuated brake-shoe *G* prevents disk *F* from turning when pawl *E* comes to rest or passes clear of the indexing slots.

In designing the pawl for such a jig, care should be taken to see that the pawl is not so long that it will enter the locking slots instead of the indexing slots. The pawl may have to be longer or shorter for disks with different numbers of indexing slots, so as to bring it into the correct relation with these slots on the up strokes of the machine spindle. The pawl is designed to pull back out of the way of the indexing disk on the down strokes of the spindle.

While this jig was designed for a hand-operated drilling machine, it could be used on machines having an automatic spindle feed and return. In such an installation, the drilling operation and work indexing would be fully automatic. It would only be necessary for the operator to clamp the work in place and remove it when finished. One person could run at least two machines, and possibly more, depending upon the depth of the drilling and the number of times that each piece had to be indexed.

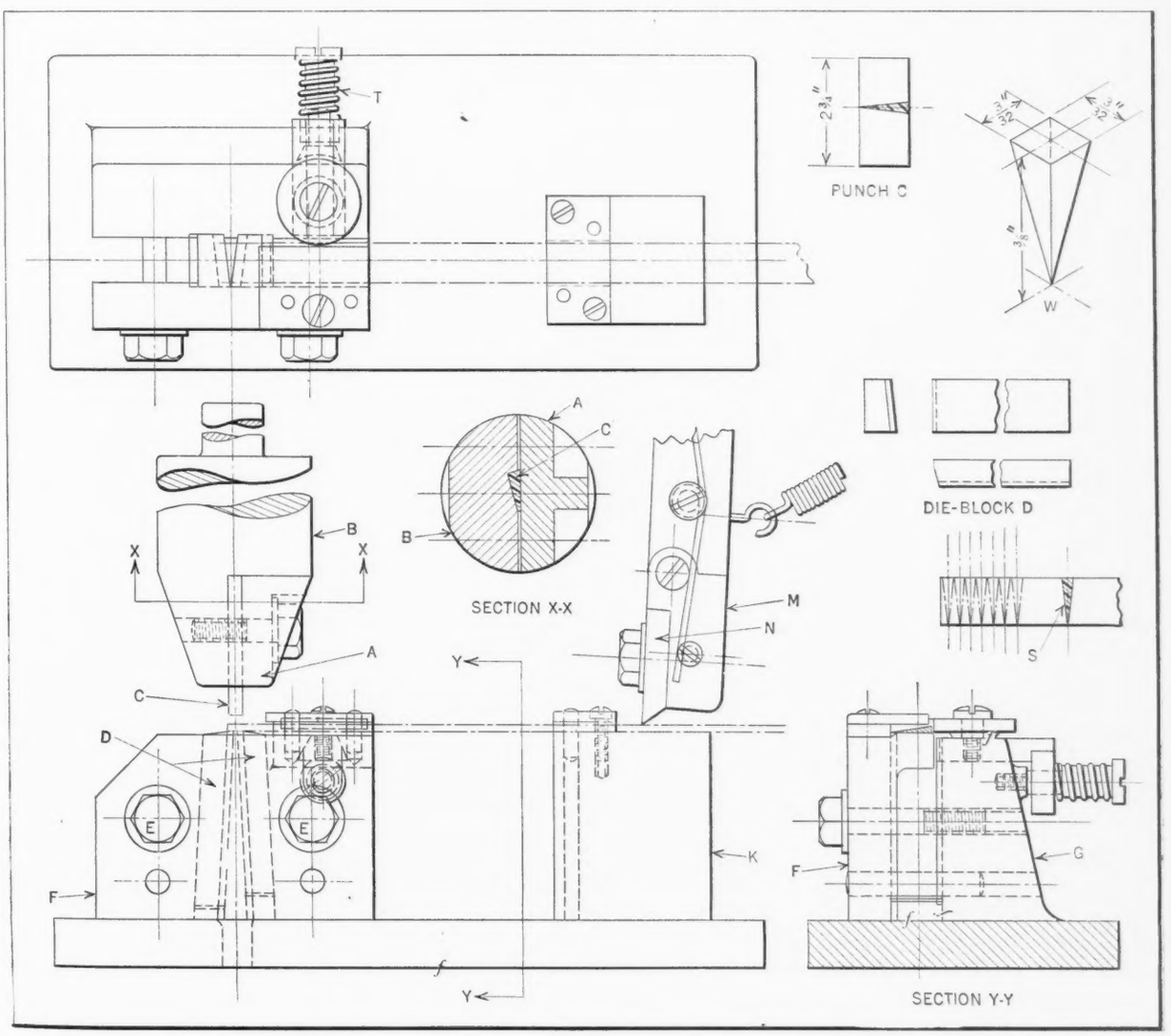
Die for Producing Small Pyramid-Shaped Pieces

By HENRY W. BOEHLY, Richmond Hill, N. Y.

The specially designed die shown in the accompanying illustration was made for producing large quantities of small wedges or pyramid-shaped pieces such as shown at *W*. These small pieces are cut or blanked out from special rolled stock having a cross-section such as shown at *S*. The rams of the small presses used for this work operate continuously, being stopped only when a new roll of stock is being put in place. As the die operates twenty-four hours a day, it is necessary to have it designed to permit the punches and the die members to be readily sharpened.

The die consists of two blocks *D*, which are sharpened on the cutting edges as soon as they become dull. These two members can be easily removed by loosening the two screws *E* and removing the front plate *F* that holds the die-blocks against the baseplate *G*. The baseplate and the front plate have grooves in them that are accurately machined to fit the die-blocks. The shortening of the die-blocks by grinding is compensated for by inserting thin pieces at the bottom end of the blocks. The stock is held firmly against the side of the stripper plate by a hardened steel roller mounted in a dovetailed slide in the baseplate. The tension of spring *T* is adjusted to exert just enough pressure on the stock to keep it located properly.

The stock is fed into the die by means of the rocker arm *M*. This arm is of right-angle form and so designed that at every upward stroke of the ram the end of the arm comes in contact with a stop which causes the hardened steel knife *N* to dig into the stock slightly and move it forward. The amount of this movement is, of course, accurately adjusted. The rocker arm is returned to the feeding position by a spring. A small additional spring was applied to the hinged end of arm *M* to permit the knife *N* to slide back over the work without scratching the surface. A feed retainer was used in order to prevent the stock from moving during the return stroke of the feeding arm.



Special Die with Automatic Feed Designed to Cut off Pieces W from Stock Having Cross-section S

The punches *C* can be removed for sharpening by simply loosening two bolts that hold the clamping jaw *A* in position. Shortening of the punch by grinding was compensated for by placing thin pieces at the upper end. With the punch and the die-blocks mounted as described, it was a very simple matter to keep these members in good cutting condition. The tools operated from three and one-half to five hours before having to be ground, the time depending on the hardness of the material.

Die of Swivel Design for Making Double Bend in Thick Stock

By A. G. AMOS, Howrah, India

An unusual type of hot-bending die for forming machine-steel plates having a cross-section of 1/2 inch by 6 inches is shown in Figs. 1 and 2. Two bends are made in the plate indicated at *D*, Fig. 1, as the die swivels under the action of the punch member. Through this swiveling action both die members tend to force the end of the plate against the locating stop, thus preventing the shifting of the plate during the bending operation.

Previous to the design of this die, a double V-type die of solid construction was used, but considerable shifting of the material occurred after the blank had cleared the locating point. Moreover, the bends were not clearly defined, especially when the plate happened not to be hot enough. The die shown, however, overcame these difficulties. It consists of the punch member *A*, the die-bed *C*, and the die *B* which is free to swivel in the die-bed. In Fig. 1 the plate is indicated in the loading position with the right-hand end against the locating shoulder or stop on the swivel die.

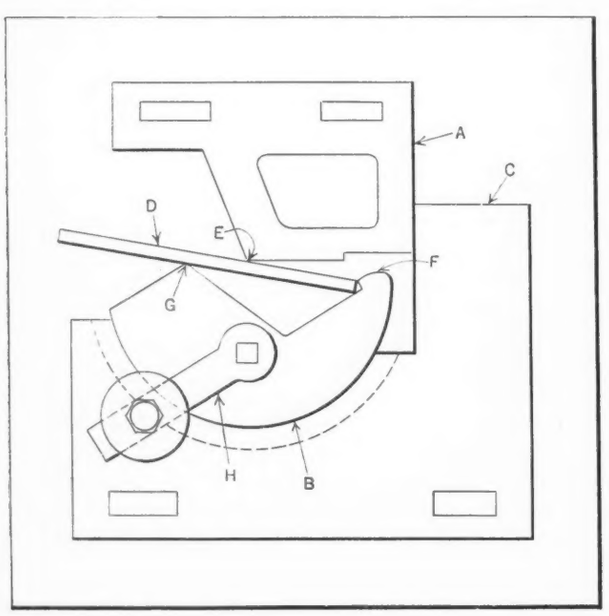


Fig. 1. Hot-bending Die in which Swivel Action Prevents Shifting of the Blank by Forcing it Against a Locating Stop

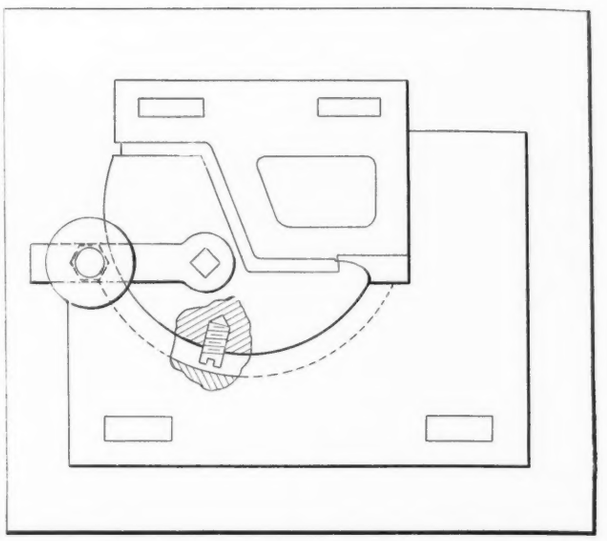


Fig. 2. Die Shown in Fig. 1 in the Closed Position

When the press is tripped, the plate starts to bend at point *E*, after which point *F* of the swivel die comes in contact with the punch, causing the die to swivel in a clockwise direction. As the swiveling movement continues, point *G* on the die forces the plate into the angular notch in the punch, and when the ram has reached the end of its stroke, both bends are finished at the same time. Two weighted arms *H* return the die to its loading position upon the return of the press ram.

Fixture for Milling an End Cam

By A. E. GRANVILLE, Knox, Ind.

The fixture shown in the accompanying illustration is used in milling the cam surface on the end cam *A*. A considerable number of these cams are required to replace those that become worn. The machines on which the cams are used are made in different models, each of which requires the back of the cam to be turned to suit its particular dimensions. Hence, a good supply of the cam castings is kept on hand, ready to be machined to suit the specifications received with rush orders for replacements.

After the back of a cam casting has been turned and bored according to order, the cam is mounted on the fixture, which can be quickly placed on the milling machine table and adjusted for milling the cam surface. The whole operation can be performed quickly, after which the fixture can be removed to permit the milling machine to continue its regular work. The cam is held to the spindle of the fixture by a heavy cap-screw *B*. The two cap-screws *C* hold the cam on the machine on which it is used, and are not needed when milling.

The master cam *D* at the rear of the fixture spindle is accurately cut, hardened, and ground. The work-spindle is rotated by the handwheel *E*, mounted on a shaft with a worm which engages a

worm-wheel secured to the work-spindle at about its middle point. The operator rotates the work by means of wheel *E* as fast as the cutter *F* can remove the metal and at the same time give a good finish. The fixture described is inexpensive to make, produces the same rise on all cams without adjustment, and is easily and quickly handled.

Quenching Machine Die for Steering Gear Sector

By D. L. BROWN, Summit, N. J.

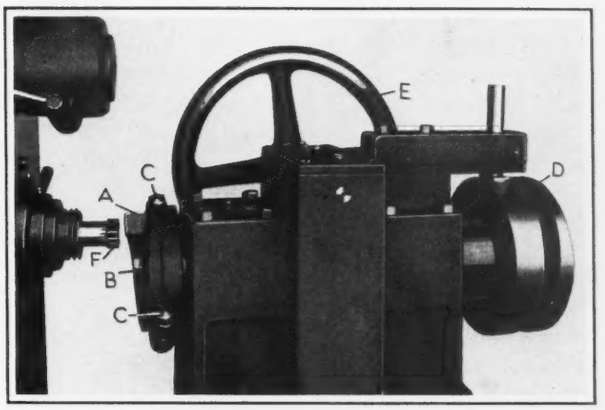
In one type of quenching machine, the work is gripped in dies between the ends of two vertical rams which are located one above the other. These rams, with the dies and work, are then submerged in a quenching bath in the base of the machine. The object in gripping the work thus is to prevent distortion during the cooling process. For flat or straight work, the dies are usually of simple design. However, when irregular work must be quenched, the design becomes more complicated.

In the illustration are shown dies used in one plant for holding a steering gear sector. In quenching this part, it is essential that the gear segment remain square with the axis of the tapered shaft. As the pressure required to hold the segment was greater than that developed by the quenching machine available, a clamping action utilizing the principle of the wedge was employed to increase the pressure.

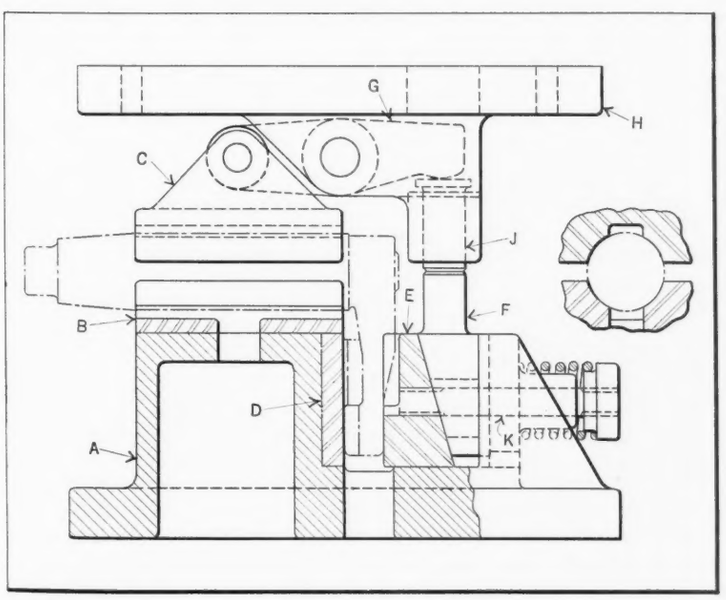
On the lower die member *A* is secured the nest *B* in which the sector is held by the clamping block *C*. Plate *D*, secured to the lower die member, serves to square up the gear segment with the shaft. The segment is held rigidly against this plate by the slide *E*, which is given a horizontal movement against the segment by the wedge *F*. The clamping movements of both block *C* and slide *E* are obtained by an equalizing lever *G*, pivoted to the upper die member *H*. The left-hand end of this lever is pivoted to block *C*, while the other end exerts a vertical pressure on wedge *F* through the plunger *J*.

Slide *E* is kept in contact with the wedge by the action of the coil spring against the nut on bolt *K*, which is screwed in the slide. With this arrangement, slide *E* is held in the open position when the dies are being loaded. To insure adequate quenching of the work surface, channels were cut in the nest *B* and the block *C*, as indicated in the cross-section at the right.

Pressure alone does not always prevent distortion after hardening, because the work may spring out of shape after the pressure is released. This condition can be overcome in the die described by shimming the plate *D* at the proper point to offset the distortion and by grinding the face of slide *E* parallel to plate *D*. The point at which the shimming is to be done can be determined by experiment.



Fixture with Barrel Type Master Cam for Milling Helical Face of End Cam



Die with Equalizing Arrangement for Holding a Steering Gear Sector in a Quenching Machine

Tools with Interchangeable Facing, Grooving, and Recessing Cutters

By CHARLES C. TOMNEY, Chief Tool Designer Brunswick-Kroeschell Co., New Brunswick, N. J.

A tool-holder that proved very satisfactory for machining the ends *A* and *B* of the angle-valve shown in Fig. 1 is illustrated in Fig. 2. This tool is used in a turret lathe for quantity production work. With this holder, it is unnecessary to turn each set of blades or cutters in the holder, as was the case with some of the tool-holders that were rejected as unsatisfactory. Spare blades, such as shown at *P* and *R*, Fig. 1, can be machined on a milling machine without mounting them in the tool-holder.

The shank or body of the tool *C*, Fig. 2, is made of steel and has a flat milled

at *D*. A hole *E*, 11/16 inch in diameter, is drilled and reamed to fit the four-fluted core-drill *F*. Hole *E* is counterbored at *G* to receive a steel bushing *H*, 1 inch long, which is also reamed to fit the drill *F*.

A slot *J*, 5/16 inch wide and 1 inch deep, is milled across the face of the tool-holder. After the slot is milled, the bushing *H* is forced into place. The blades *K* are held securely by two set-screws *L* in the steel collar *M*. The set-screws press the blades against the bushing *H*. The collar *M* is held in place by set-screw *N*. Set-screw *O* holds the drill *F* in position. No difficulty is experienced in holding the drill *F* with a set-screw, because the holes to be drilled are cored out so that a comparatively light cut is required.

The tool illustrated in Fig. 2 is employed for grooving the end *A*, Fig. 1, using the blade shown at *P*. Each end of the valve is first faced with a round-nosed tool held in the turret toolpost. A pair of blades like the one shown at *R* is used in another tool-holder, similar to the one illustrated, for machining the end *B* of the valve. In this case, it is necessary to machine close to the drill, and the position of the set-screw *O* is shifted so that the flutes will be in the position shown at *S*, Fig. 1, with the cutting edge overlapping the inner edge of the bushing. This arrangement allows the drills to be interchangeable.

* * *

Gear-testing machines are now available by which spur, bevel, helical, and worm gears can be tested for circular pitch, eccentricity, uniformity of tooth space, and uniformity of tooth thickness, all in a single device, the readings being obtainable with an accuracy of 0.0001 inch.

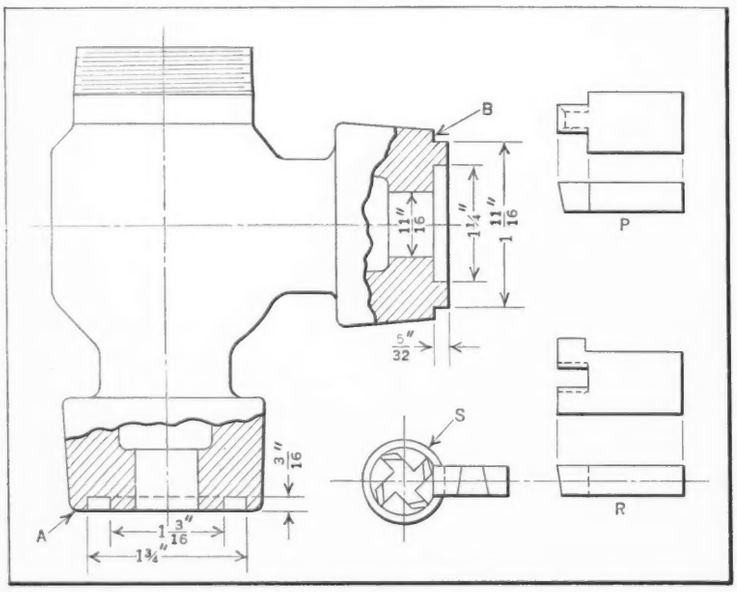


Fig. 1. Angle-valve and Cutters Used in Machining Ends A and B

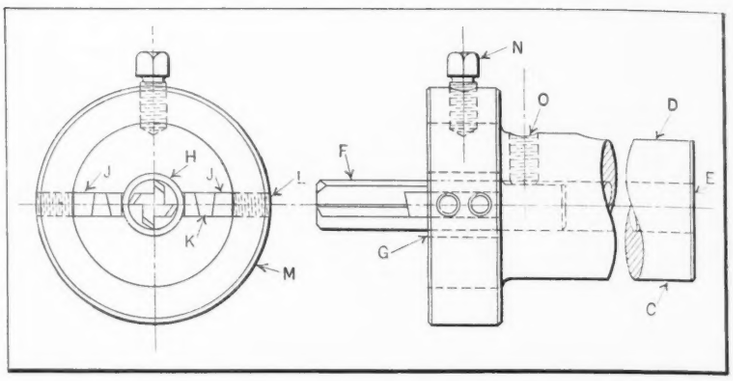


Fig. 2. Holder for Interchangeable Cutters Like the Ones Shown at P and R, Fig. 1

A Machine that Almost Thinks

A vending machine has been developed that certainly may be termed "almost human." It may be applied to selling such things as movie or theatre tickets. The apparatus consists of a comparatively simple sheet-steel box with slots to receive coins of different denominations, and contains an adjustable mechanism that can be set to suit the price of the object being sold.

For example, when adjusted to sell movie tickets at a certain price, any number of coins of the same or different denominations may be inserted in their respective slots, and if the coins inserted total the specified amount, the machine returns a ticket. If change is required, the exact change will also be forthcoming. It makes no difference whether one large or several small coins are inserted. On the other hand, if the inserted amount is insufficient, it will be returned complete without a ticket. The machine can also be used in subways, street cars, or any place where change has to be made. It will sell numbered admission tickets, and in that case is supplemented with an apparatus that shows the numbers of the unsold seats available in the theatre.

* * *

Remarkable Results from a Chromium-Plated Reamer

In the *Journal* of the American Society of Tool Engineers, 8316 Woodward Ave., Detroit, Mich., Edward C. Lee, chief tool designer of the Chrysler Corporation, states that because of the close limits of the valve tappet holes in cylinder blocks, high-speed steel finishing reamers produced only 1200 holes before they wore under-size. A tungsten-carbide tipped reamer produced 72,000 holes within the prescribed limits. The only difficulty with this reamer was that the body wore down directly behind the tips. With a chromium-plated reamer, over 1,600,000 holes were produced.

PORTABLE DRILLS WITH JACOBS TAPERS OR THREADS FOR CHUCKS—3

Model Number of Portable Drill	Chuck Size, Inch	Taper No. or Thread Size, Inch
Louisville Electric Mfg. Co., Louisville, Ky.	*(Pioneer)*	
00UB, 00UBS	1/4	3/8
1US, 00UC	5/16	1/2
1UA, 1U, 1UW (woodwkg.)	3/8	5/8
SUS, 6U, Garage Special	1/2	5/8
7U, 2US, 3U, 8U (Two-speed)	5/8	5/8
4US	3/4	5/8
Millers Falls Co., Greenfield, Mass.	*(Millers Falls)*	
316	3/16	No. 1
214	1/4	No. 1
414, 514	1/4	3/8
516	5/16	3/8
638	3/8	1/2
538	3/8	No. 2
312, 612	1/2	No. 6
658	5/8	No. 3
634, 734	3/4	No. 3
Milwaukee Electrical Tool Corp., Milwaukee, Wis.	*(Super Hole Shooter)*	
A-136	3/16	No. 1
H-114, A-114, M-114	1/4	No. 1
H-256	5/16	No. 1
BX-238	3/8	No. 1
C-312	1/2	No. 6
D-458	5/8	No. 6
E-534	3/4	No. 6
Portable Power Tool Corp., Warsaw, Ind.	*(Power King)*	
AA, AB, AC, AD	1/4	1/2
AE	5/16	1/2
BA	3/8	1/2
BB, CA, CB	1/2	3/4
Portable Power Tool Corp., Warsaw, Ind.	**(Continued)**	
BC, CC, CD	5/8	3/4
BD, CE, CF	3/4	3/4
Rotor Air Tool Co., Cleveland, Ohio	*(Rotor)*	
E-O	1/4	3/8
E	5/16	3/8
E (special)	3/8	3/8
E-1, E-1-C	3/8	5/8
E-2, E-1-C, E-2-C, E-4-C	1/2	5/8
E-2-C	5/8	5/8
E-2-C, E-4-C	3/4	5/8
Schauer Machine Co., Cincinnati, Ohio	*(Ideal)*	
L0, L1	1/4	3/8
L2	5/16	3/8
L3	3/8	5/8
L4, L4X	1/2	5/8
L5X	5/8	5/8
L6X	3/4	5/8
Speedway Mfg. Co., Cicero, Ill.	*(Speed Way)*	
49, 53	1/4	9/16
56	5/16	9/16
59	1/2	5/8
60	1/2	3/4
76 (Old USD) Marble Drill	1/2	No. E
88A, 88B	1/4	3/8
90A, 90B	5/16	3/8
92A, 92B	3/8	5/8
94	5/8	5/8
95	3/4	5/8
72 (Old UC)	3/8	No. 2
74 (Old UD)	1/2	No. E
78 (Old UE)	5/8	45/64

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PORTABLE DRILLS WITH JACOBS TAPERS OR THREADS FOR CHUCKS—4

Model Number of Portable Drill	Chuck Size, Inch	Taper No. or Thread Size, Inch
Standard Electrical Tool Co., Cincinnati, Ohio	*(Standard)*	
2UA	1/4	3/8
2UB, 2 1/2 UB	5/16	3/8
3UC, 3UB	3/8	5/8
4UL, 4UH	1/2	5/8
5UD	5/8	5/8
6UK	3/4	5/8
Stanley Electric Tool Co., New Britain, Conn.	*(Stanley)*	
140	1/4	3/8
141, 142	1/4	1/2
562	5/16	1/2
382	3/8	5/8
121, 122	1/2	5/8
582	5/8	5/8
341, 342	3/4	5/8
Stow Mfg. Co., Binghamton, N. Y.	*(Stow)*	
SO, SOU	1/4	No. 1
SI (Single-speed), SIU	3/8	No. 2
Two-spindle, New Type	1/2	45/64
2, S2U	1/2	No. 6
S3, S3U	5/8	No. 6
Temco Electric Motor Co., Leipsic, Ohio	*(Temco)*	
DS, DH	1/4	No. 1
HS	5/16	No. 1
JH	3/8	No. D
KS, KH	1/2	No. E
NS, NH	5/8	No. E
TS	3/4	No. E
Tousley Tool Co., Cleveland, Ohio	*(Air Turbine)*	
1-A, 1 1/2, 1 1/2A	1/4	3/8
Tousley Tool Co., Cleveland, Ohio	**(Continued)**	
2A	3/8	1/2
2B	1/2	5/8
United States Electrical Tool Co., Cincinnati, Ohio	*(U. S.)*	
	1/4	3/8
	5/16	3/8
	3/8	5/8
	1/2	5/8
	5/8	5/8
	3/4	5/8
Van Dorn Electric Tool Co., Baltimore, Md.	*(Van Dorn)*	
	3/16	3/8
	1/4	3/8
	5/16	3/8
	3/8	5/8
	1/2	5/8
	5/8	5/8
	3/4	5/8
Wappat, Inc., Pittsburgh, Pa.	*(Wappat)*	
	1/4	3/8
	3/8	5/8
	1/2	5/8
	3/4	3/4
Wodack Electric Tool Corp., Chicago, Ill.	*(Wodack)*	
	3/16	3/8
	1/4	3/8
	5/16	3/8
	3/8	5/8
	3/8	No. 2
	1/2	5/8
	5/8	5/8
	3/4	3/4

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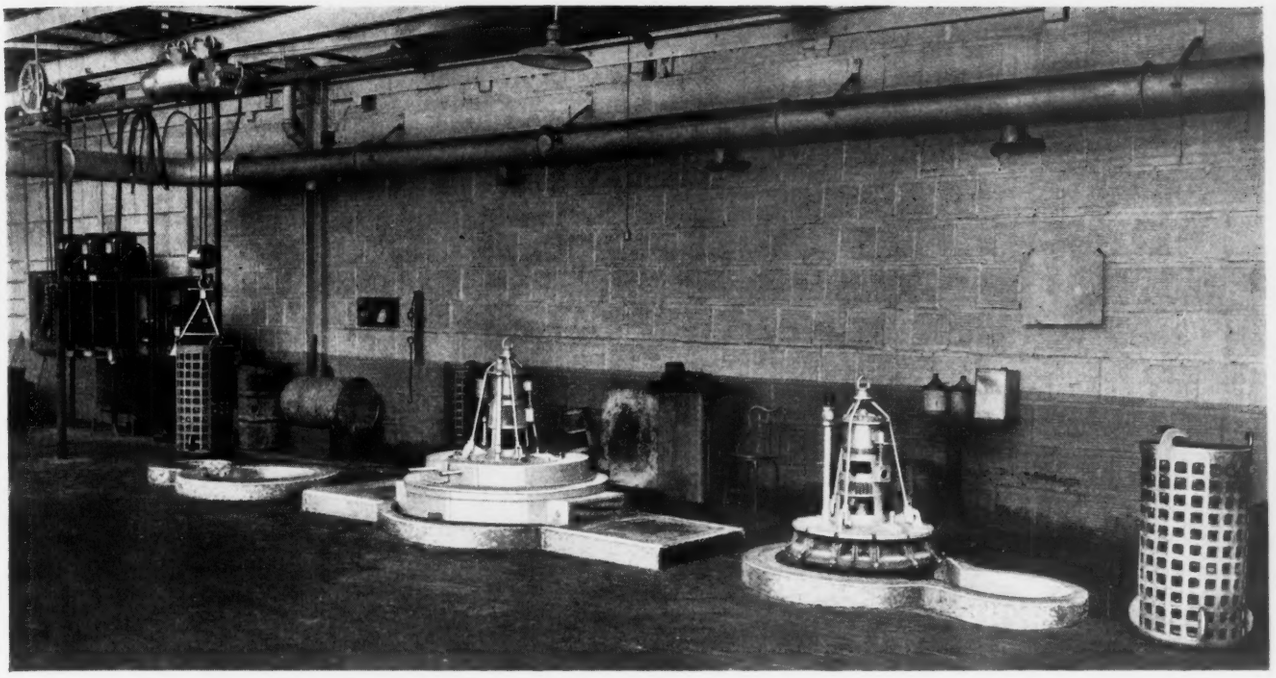


Carburizing Small Parts by the Carbonol Process

Heat-Treating Screw Machine Products in an Automatically Controlled Electric Furnace Equipped for Producing Carburizing Gas from Oil

By E. M. SLAUGHTER, Metallurgist
National Acme Co., Cleveland, Ohio

THE so-called "Carbonol" process of carburizing consists primarily of heating the work thoroughly in a retort and then admitting oil, which is caused to impinge on the hot walls of the retort by a rapidly revolving fan. The oil is thus transformed into an active carburizing gas. The means provided for accurate control of the heat and the amount of oil admitted make it possible to obtain uniform results. The installation shown in the heading illustration has been in operation at the plant of the National Acme Co. for about a year. This equipment is a typical example of the Carbonol process of heat-treating developed by the Hevi Duty Electric Co., Milwaukee, Wis.

With the methods employed prior to the installation of this equipment, it was difficult to obtain uniform case depth and case composition. The exacting requirements of the automotive field, in particular, make it imperative that these two factors be controlled to within relatively narrow limits. Tolerances in case depth rarely exceed 0.015 inch, and the carbon concentration of the case is seldom permitted to exceed 1.10 per cent.

Features of Furnace and Lay-out of Equipment

The furnace is of the vertical type, electrically heated with a 66-kilowatt rating. In the heating zone is an alloy retort containing the work basket, which is 18 inches in diameter by 36 inches in depth. To the top of the retort is bolted the cover, which contains the fan mechanism and the oil reservoir. These details are all shown in the heading illustration.

Three thermo-couples, two in parallel, control the three heating zones. The bottom and middle zones operate from a Leeds & Northrup indicating pyrometer, and the upper zone operates from a Leeds & Northrup recording pyrometer. Both instruments have front dial setting, which facilitates operation. Three separate control panels are equipped with two sets of lights each, wired so that red lights indicate that the fuses are O.K. and the current is passing to the furnace. Blue lights indicate time when contacts are in, thus providing an easy means of calculating the total amount of current used during any desired cycle of operation.

As will be noted from the heading illustration, the furnace proper is more than three-fourths below the floor level. On the sides of the furnace pit are two wings, which provide easy access to the terminal boxes and the thermo-couple ports. A cooling pit of suitable size and depth is shown on each side of the furnace. These pits provide uniform cooling of the alloy retorts after they have been taken from

the hot furnace. Adjoining these cooling pits are smaller pits in which the loaded baskets are placed prior to being loaded into the retort. An electric overhead crane affords easy and efficient operation.

Operation of Equipment

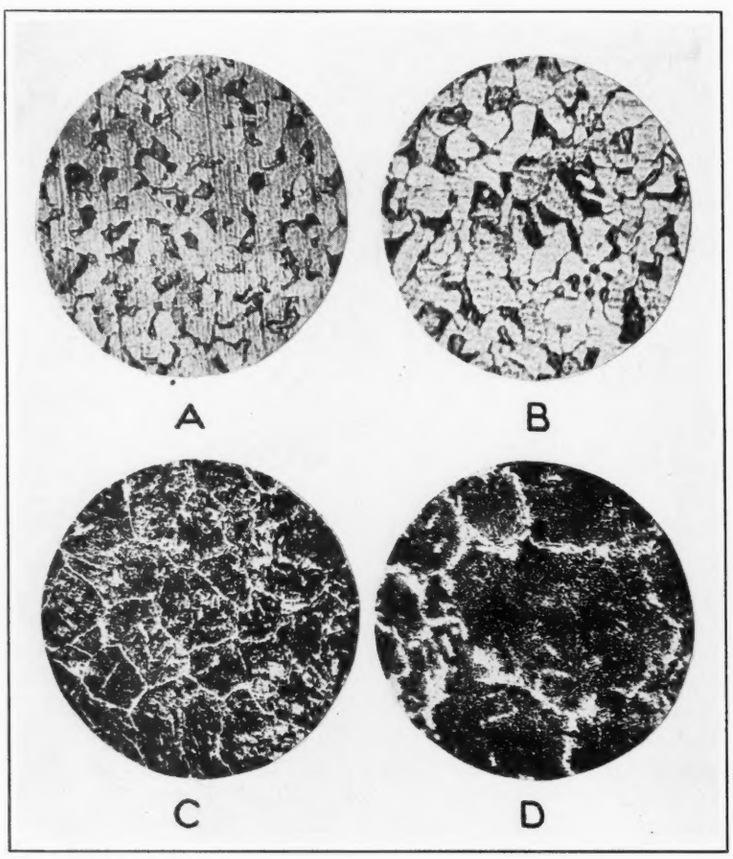
The work to be carburized is loaded in a basket, such as shown to the right in the heading illustration. Divider plates are provided so that an extremely dense load can be broken up or so that various parts requiring the same amount and type of case can be processed at the same time. The loading basket is then put in the pit for preheating, after which it is placed in the retort and the cover bolted in place. This entire unit is then lifted from the pit and placed in the furnace, where it is brought up to the required temperature. With extremely dense loads, it is advisable to preheat the charge from one-half to one hour before starting the oil drip.

After the charge is thoroughly heated, the oil is dripped into the retort, first coming in contact with the revolving fan, by which the oil is impinged against the sides of the hot retort. The result of this action is a volatilization of the oil into an active carburizing gas. The time that the drip is started, as well as the speed or amount of drip, depends on the depth and type of case that is to be produced.

After the carburizing is completed, it is often advisable to soak the charge to allow diffusion of the case. This is especially important if the charge has been subjected to carburizing for a long period of time, in which excess cementite has formed near the surface of the steel. This diffusion period is also beneficial in that it results in a better union between the case and core. By the term "soaking" is meant holding the charge at heat without further addition of carburizing oil.

Free cementite in the case can be broken up by means other than that described. To do this, however, means heating the parts above the Ac critical point, followed by drastic quenching. Such a treatment is not always permissible, because distortion and change of size must often be held to a minimum. It is a pretty well established fact that a double quench treatment causes more distortion than a single quench for case refinement only.

There are many parts that can be quenched directly from the carburizing container. Suitable fixtures or means can be provided to handle work of this nature. Most of the work handled by the installation shown in the heading illustration is slow-cooled in the retort and later reheated, either for case refinement only or for refinement of both core and case. The type of part and the customer's requirements govern the procedure.



SAE 1020 Steel Magnified 150 Times: (A) Before Carburizing; (B) After Carburizing; (C) Hypereutectic Case Produced by Carbonol Process with Oil Drip Regulated for 270 Drops per Minute; (D) Hypoeutectic Case Produced by Soaking a Eutectic Case

When the hot retort is taken from the furnace after the carburizing, it is placed in a cooling pit. Adjacent to this pit is a preheating chamber in which there is a basket loaded with "green" work, which is heated to about 300 or 400 degrees F. by the time it is loaded into the retort. Thus the entire unit is systematically planned for economy and efficiency.

There are many different types of work, materials, and specifications that must be taken into consideration in the daily operation of such a unit. To enumerate the various types of steel, case depths, hardness specifications, and shapes of parts carburized by this process would be difficult. A few examples will serve to give an idea of the results that can be obtained.

As an example, a charge of SAE 1020 steel was carburized at 1690 degrees F. for the periods of time given in the following. The flow of the carburizing oil was noted. Later, a similar test was made, except that the flow of oil was doubled. In each instance, the depth and type of case were

studied. The following results were obtained with an oil drip of 135 drops per minute:

Time	Case Depth	Type of Case
1 hour	0.012 inch	Eutectic
2 hours	0.018 inch	Eutectic
3 hours	0.028 inch	Eutectic

With three hours of oil drip plus one hour of soaking, the case in the above test became hypo-eutectic.

The following results were obtained on the same steel, but with an oil drip of 270 drops per minute:

Time	Case Depth	Type of Case
1 hour	0.018 inch	Hyper-eutectic at extreme edge
2 hours	0.030 inch	Hyper-eutectic for about 0.010 inch
3 hours	0.040 inch	Hyper-eutectic for about 0.014 inch

With three hours of oil drip plus one hour of soaking, the case showed a depth of 0.044 inch, and the amount of hyper-eutectoid was reduced to 0.005 inch.

It is our experience that the relation of the amount of carburizing oil dripped per minute and the total amount of area to be carburized is a paramount factor in the successful operation of the process. Excess oil will cause a soot deposit, which is disagreeable in many respects. Such a condition, if allowed to become excessive, may even retard carburizing. However, injection of air through the port in the cover will minimize this condition.

A study similar to the one applied to the S A E 1020 steel was also made of S A E 2315 and S A E 3115 steels. In general, the same difference in case penetration and type of case produced by the two rates of oil injection were noted. However, with these two types of alloy steels, the case penetration was slightly greater, and in each instance, there was much less tendency to form a cementitic network near the surface of the specimens.

The accompanying photomicrographs show some of the usual conditions encountered in the processing of S A E 1020 steel. The grain size of the core is somewhat larger after three hours at carburizing heat. Again, this condition is very much less marked in S A E 2315 steel and S A E 3115 steel. There are many conditions that might alter the foregoing conclusions, however, such as the manufacture and inherent characteristics of the steel itself. We believe that, in general, the alloy steels will show less grain growth during a carburizing cycle than the plain carbon steels.

The advantages of the Carbonol process experienced in the operation of the installation described may be summarized as follows: Very close control of temperature is possible; a large amount of work can be processed per volume of space occupied; case depth can be held to very close limits; various types of cases can be produced; diffusion, which is possible with this process, can be utilized to vary the case according to requirements; and a comparatively small amount of labor is required per pound of material processed.

Economy of Increased Feeds and Speeds in Machining Free-Cutting Brass*

Extensive tests have been made under actual shop conditions to determine the life of automatic screw machine forming and drilling tools in machining free-cutting brass. The data obtained from these tests show that heavier feeds and higher cutting speeds than those used in current practice can be combined with a reasonable tool life. The relation existing between the cutting speed, feed, and life of the tool, as found by Frederick W. Taylor and others, in rough-turning steel, does not exist in the forming and drilling of free-cutting brass. Within the limits of the tests, an increase of the cutting speed is accompanied by greater economy.

In machining free-cutting brass with ground, circular forming tools, the life of the tool between grinds appears to be nearly independent of the feed and of the cutting speed, and to depend primarily on the linear distance the work moves at the point of contact with the tool.

Within the limits of the tests, the maximum economy in machining free-cutting brass is secured by using the heaviest feed that the work and tools will stand and running the stock at the highest spindle speed available. The tests have been conducted over a period of five or six years in the screw machine laboratory of the Brown & Sharpe Mfg. Co. In all cases, the cutting lubricant was a commercial mineral lard oil.

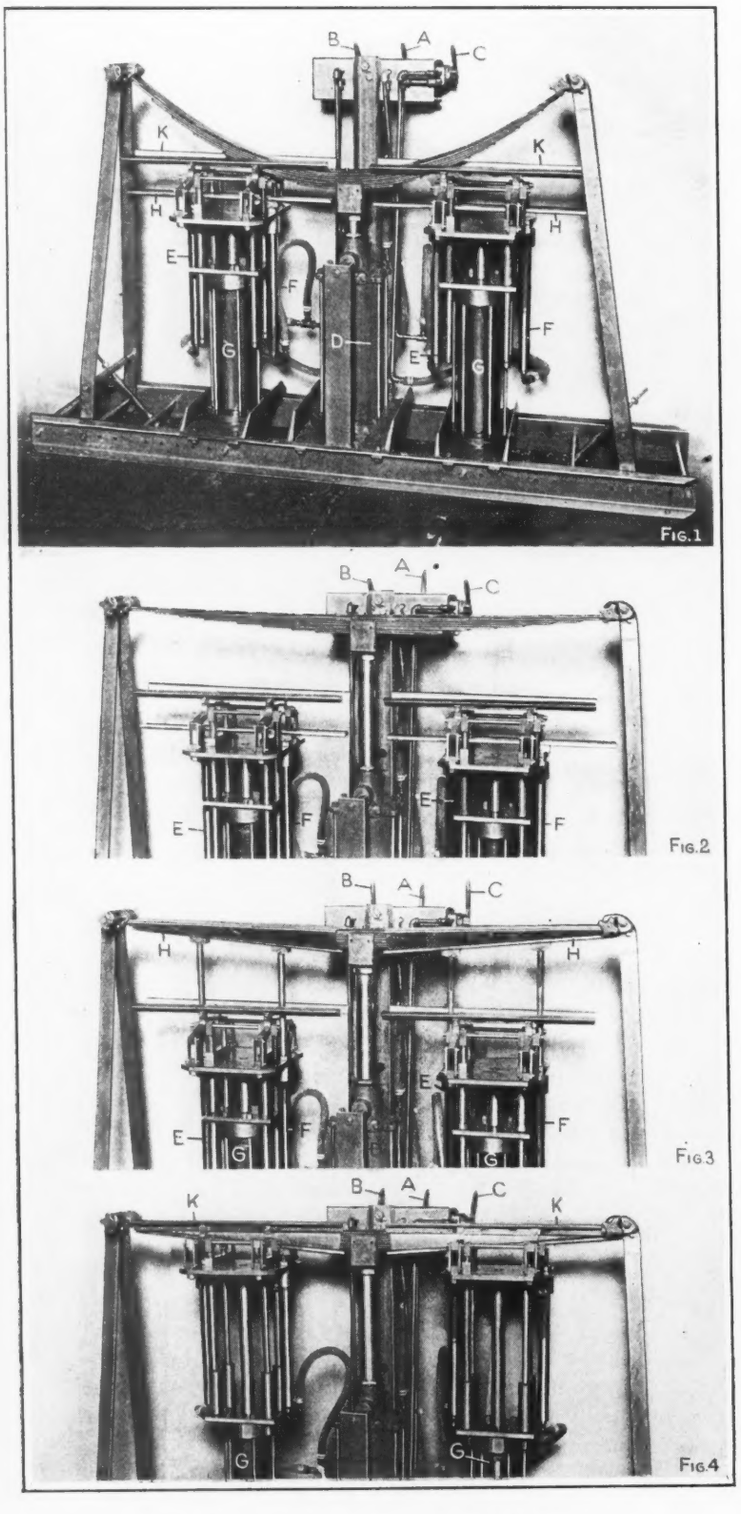
Another conclusion of the tests has to do with the relative merits of carbon and high-speed forming tools. At the time of the first tests, there was a strong feeling among users of screw machines that carbon steel was preferable for form tools when a fine finish was required on the work. Probably this was due to the fact that high-speed steel tends to become deformed in hardening at the high temperature required, and the practice of grinding form tools after hardening had not been generally adopted.

These tests show definitely that longer life can be expected from high-speed steel even for fine finishes. For cutting-off tools, the advantages of high-speed steel over carbon steel are not so obvious as for form tools.

*Abstract of a paper presented by L. D. Spence and J. A. Hall at the semi-annual meeting of the American Society of Mechanical Engineers.

Fastening Metal Covers on Automobile Springs

By CHARLES O. HERB



Figs. 1 to 4. Steps in Assembling Metal Covers to Automobile Springs on an Air-Operated Machine—Output, One Spring a Minute

DURING the last few years, automobile manufacturers have adopted the practice of packing grease around the springs and enclosing them in leather or metal covers. One popular metal cover consists of a long straight top piece having a cross-section such as shown at *X*, Fig. 5, and a lower member made up of pieces shaped as indicated at *Y*. The pieces of the lower member are tapered on the bottom so that their depth diminishes gradually from the middle of the spring toward the end, corresponding with the decreasing number of leaves. The different pieces of member *Y* are attached to each other in such a manner as to provide the utmost flexibility in a vertical direction when the spring has been installed. Members *X* and *Y* are both made of terne plate 0.020 inch thick.

Member *Y* is slipped on the spring from the bottom and then compressed on the sides, after which the top piece *X* is slid on member *Y*, locking the entire cover in place. The top piece is finally flattened down on the spring.

Considerable pressure is required in this cover-assembling operation to close in the sides of member *Y*. This is because the spring leaves must be aligned vertically with each other and they are sometimes as much as 1/8 inch out of place. For this reason it has been found preferable to assemble the covers by machine rather than by hand; in this way, greater output is also obtained.

The illustrations show an air-operated machine, covered by two patents, built by the Hannifin Mfg. Co., Chicago, Ill., for this operation. This machine is of duplex design so that two operators can assemble covers simultaneously on the opposite ends of a spring. Fig. 1 shows the machine at the beginning of an operation, with the spring suspended from hinged bars, which enable it to be set up while retaining its natural camber. After the spring has been loaded in this manner, one of the operators trips valve lever *A* to admit air into the cylinder *D*. This causes the ram of the cylinder to rise and straighten out the spring, as shown in Fig. 2. In this position, the spring is clear all around, so that the operators can conveniently apply graphite grease on all

sides and then wrap canvas around the spring to retain the grease. Cylinder *D* is equipped with an 8-inch piston. At a pressure of 80 pounds per square inch, it develops a total pressure of 4000 pounds.

Each operator next slips the lower member of the metal cover on the spring and moves either valve handle *B* or *C* (depending upon the side of the machine on which he is working) into the vertical position. This admits air into the corresponding small-diameter cylinders *E* and *F*. Thus the platen *H*, Fig. 3, is forced upward against the bottom spring cover, holding it securely in place and freeing the hands of the operator for the following steps. Platens *H* position themselves automatically at an angle to suit the slope of the spring.

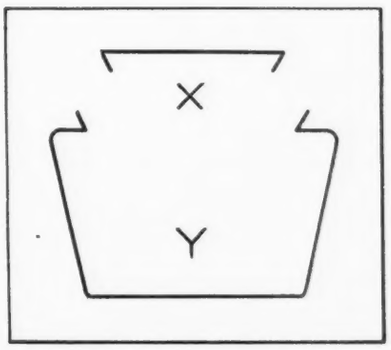


Fig. 5. Cross-sectional Diagrams of the Two Members that Comprise a Metal Spring Cover

Each operator next pushes handle *B* or *C* to another position for admitting air into the corresponding cylinder *G*. The ram of this cylinder rises until angle-irons *K* are brought up to the metal cover, as seen in Fig. 4. At this point, the angle-irons swivel automatically and exert a heavy pressure on the sides of the cover so as to close them on the spring, and at the same time, force all the spring leaves into line with each other. The top piece *X*, Fig. 5, of the cover can now be readily slipped on member *Y*. Cylinders *G*, Fig. 4, each develop a pressure of about 2500 pounds.

With machines of the type referred to, an ordinary pneumatic riveting hammer may be employed for flattening down the top piece of the metal cover or a block of wood and a mallet can be used. However, the latest model built by the concern is equipped with a simple overhead structure consisting of two channel irons that form a track for air-operated hammers *J*, Fig. 6. When the valve lever at the top of either one of these units is operated to admit air into the cylinder, the pneumatic hammer unit moves down until it is nearly in contact with the top of the spring cover. At the moment the downward movement ceases, the unit commences hammering.

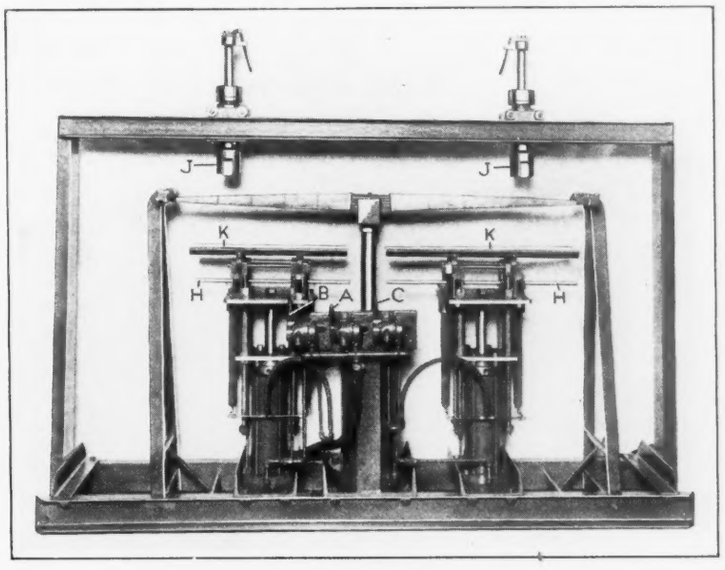


Fig. 6. Air-operated Riveting Hammers of Unusual Construction are Provided on the Latest Machines for Closing Down the Top Cover Piece

Previous to this, the operator has moved valves *B* and *C* to lower the supporting bars *H* and angle-irons *K* clear of the work. The riveting hammers *J* can be traversed back and forth at will, and their hammering units rise and lower automatically to compensate for changes in the slope of the cover top as it is closed down. These hammers make about 1800 strokes per minute. With the equipment shown in Fig. 6, the two operators average a completed spring per minute. Adjustments to suit different types of springs can be made very quickly—in five minutes or less.

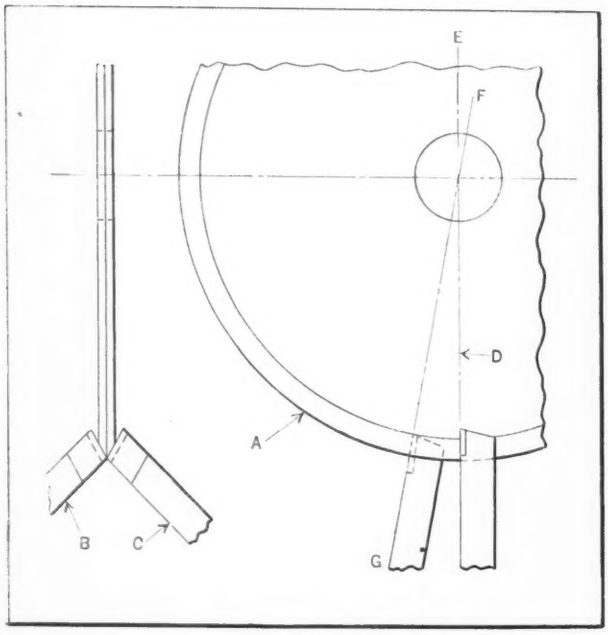
* * *

Vacuum Tubes and Gyroscope Keep Ships Stable at Sea

The possibility of stabilizing large ships by means of a new type thyratron control equipment, utilizing vacuum tubes and a small gyroscope, has been demonstrated by Dr. E. F. W. Alexanderson, consulting engineer of the General Electric Co. Using a small laboratory model, Dr. Alexanderson has been able to imitate the rolling of a large vessel and show how his device not only would immediately restore the ship to an even keel but keep it stable, regardless of wave motion. His plan is either to use fins, designed like streamline rudders, attached to opposite sides of a ship, or to utilize the force of gravity by changing weights, which may take the form of pumping water from one tank to another. When the fins are used, they tilt up or down according to the roll of the ship, very much as the wings of a sea-gull which keep the bird in perfect balance in the air. The movement of these fins is actuated by a small gyroscope, which relays its tiny impulses, greatly amplified by means of the thyratron control, through wires to motors built inside the fins. Thus, if the ship should be inclined to roll to one side, the fins would immediately be tilted down on one side and up on the other, and vice versa, as reversed conditions occur.

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work



Positions of Tools for Turning Sharp Edge on Disk

Turning Sharp V-Shaped Cutting Edge on Disk

The kink described here was used in turning a bevel on a disk 8 inches in diameter by 1/16 inch thick. The bevel was required to give a sharp cutting edge, as shown on disk *A* in the accompanying illustration.

At first, two tool-holders were mounted in the lathe with their cutting faces in the same plane as the center line *D–E*. With this arrangement, the chips collected between the tools *B* and *C*, producing a ragged cutting edge. The tool bit *B* was then raised or relocated with the cutting face in the plane *F–G* at an angle of about 10 degrees with the plane *D–E*. This arrangement allowed the chips to fall away so that a clean sharp cutting edge was obtained.

Rockford, Ill. W. E. GUNNERSON

The Note-Book Habit Develops Mechanical and Engineering Ability

A habit that will prove of great value to the young mechanic, and that should be acquired in the first year of apprenticeship and continued for life, is that of keeping a note-book. This does not mean that he should secure a nice blank-book and keep it blank, but rather that he should make notes of everything, in the shop or outside, that seems to him unusual and that might sooner or later be of use to him, regardless of how remote its possibilities may seem at the time.

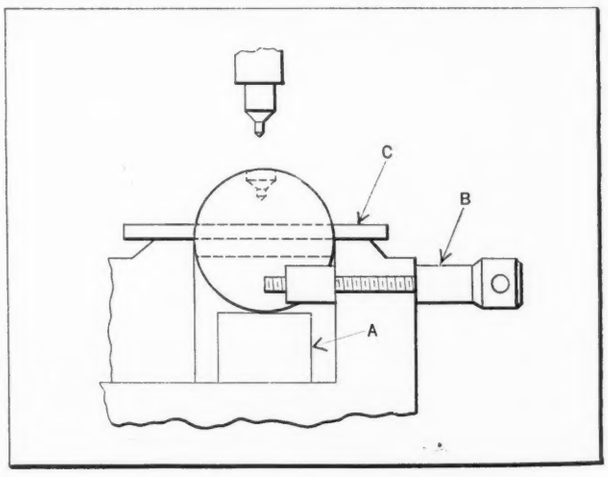
The average beginner will be surprised to find how difficult it is to describe a comparatively simple mechanical movement so that it will be intelligible even to himself a few weeks later. This indicates one of the advantages of using a note-book. The note-book user not only learns the art of making good sketches rapidly, but also acquires the ability to describe in a correct and concise way anything in which he is interested.

The note-book habit is one of the most reliable means of gaining a large fund of general information. No attempt should be made to make permanent notes on the spot. It is better to make rough sketches on any kind of paper at hand, in order to show dimensions and details that would be difficult to remember. Then the permanent notes can be made from memory with the aid of the rough sketches. The notes should, of course, be made as complete as possible, as incomplete notes are generally worse than useless.

Ontario, Calif. H. R. HAGEMAN

Drilling Cross-Holes in a Shaft Without a Jig

Cross-holes in shafts can be drilled accurately at right angles to each other by employing the method illustrated. No jig is required. The shaft is clamped between the jaws of an ordinary vise and supported on block *A*. The vise is secured to the drill table



Method of Squaring up a Shaft for Drilling Holes at 90 Degrees to Each Other

and the shaft is located endwise against the parallel clamp *B*. The first hole is drilled and then the shaft is released and rotated 90 degrees. Arbor *C* is now passed through the drilled hole, as indicated, and the block *A* removed. This allows the shaft to be suspended on the arbor, thus leveling the drilled hole.

The end of the shaft is now held against the parallel clamp and the vise jaws are tightened. Following this, the arbor is removed and the shaft is blocked up to provide support for the drill thrust. In starting the second hole, a combination drill and countersink is used, and this is followed by a drill of the required size.

Boston, Mass. F. RATTEK

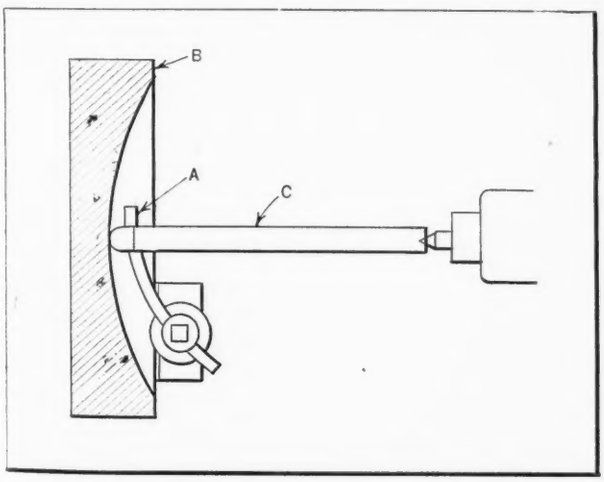
Turning Concave Surfaces of Large Radius in Cast-Iron Dies

Recently the writer was called upon to make a series of cast-iron dies with spherical surfaces. Only one die of each size was required, the sizes ranging from 8 to 16 inches for the radii of the spherical surfaces. The castings were made from molds produced with wood patterns. They were strapped to the faceplate of a lathe or held in a chuck for the radius-turning operations.

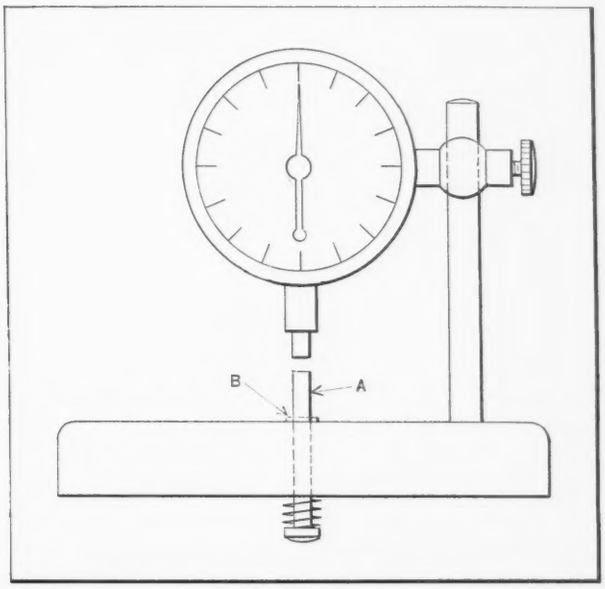
As the largest radius was 16 inches, a piece of steel bar stock *C*, 16 inches long by 1 1/2 inches wide, was centered on one end, as shown in the illustration. The other end was ground like a planer tool to a radius of 3 inches, and hardened and tempered. The toolpost was used to hold a rest *A* that extended across the work *B* as far as the center and supported the cutting tool. With this arrangement, the cutter slid on the rest and was not fastened to it.

In operation, the tailstock center is used to feed the cutter forward and keep it in contact with the work. The tool is fed from the center of the work to the outer edge by hand, the tool rest being moved as required. After the 16-inch die was completed, the cutter or bar *C* was shortened to 14 inches, centered, and used for radius-turning the next smaller die. This procedure was continued until the set of dies was completed.

Union, N. J. FRANK H. PARSONS



Lathe Set-up for Turning Concave Surfaces of Large Radius in a Cast-iron Die



Inexpensive Depth Gage for Rapid Inspection

Simple Depth Gage for Rapid Reading

The depth gage shown in the illustration is equipped with a dial indicator, and was designed for inspecting shallow slots and holes accurately and rapidly. It is set to the proper reading by means of size blocks. The dial is adjustable and is held by means of a thumb-screw on a vertical rod inserted in the gage base.

In use, the head of the measuring rod *A*, which is backed up by a small coil spring, is inserted into the hole or slot to be inspected. The base of the gage is then held against the outer surface of the work with a slight pressure of the fingers. This forces the measuring rod upward and against the contact point of the dial, which indicates the hole or slot depth. A pin *B* in rod *A* prevents the rod from falling out of the base.

Meriden, Conn. PETER L. BUDWITZ

Kink for Extending Milling Cutter Arbor

In setting up a face milling cutter with a stub arbor, it was found necessary to move the cutter about 1 3/16 inches farther away from the machine column, as it interfered with a projection on the part to be milled. A shim made of 0.027-inch stock was wrapped about the tapered portion of the arbor to bring the cutter out to the desired position. This kink has been used to advantage on several occasions.

Rockford, Ill. W. E. GUNNERSON

The Shop Executive and His Problems

Superintendents and Foremen are Invited to Exchange Ideas on Problems of Shop Management and Employe Relations

WHENEVER a concern maintains a process-and-methods department, an efficiency department, or a tool-equipment department—the name is of no special importance—it is vital to the success of the work that friendly relations be maintained with the foremen throughout the plant.

Whenever a tool engineer goes into a department for the purpose of observing the methods in use, he should first explain to the foreman what he has in mind. This will forestall any suspicion on the part of the foreman that an investigation of his department is in progress. If the management should decide upon such an investigation, because of not being fully satisfied with the results obtained, the foreman should be apprised of the facts and it should be made clear to him that the object is simply to help him get better results—not merely to find fault. The foreman should always be made to feel that any changes that may be made by the tool engineer will reflect to his own credit because of the improved results.

The tool engineer should be careful not to give the foreman the idea that he is forcing a change of methods upon him. Instead, he should discuss the idea with the foreman in a manner that will lead the latter to offer suggestions. In this way, the valuable aid of the foreman will be enlisted and he will be made to feel that he has a part in the development of the better methods which may be adopted. The interest and enthusiasm of the foreman is also an important point in the successful application of new machines and methods.

So often differences of opinion arise solely from the fact that antagonism is aroused where there is no call for anything but friendly cooperation. The man who thinks that he can attain his objectives by riding roughshod over other people's feelings usually finds that he builds up a passive resistance that ultimately will frustrate his efforts.

OBSERVER

Senseless Selling Prices

Recently a concern needed two special tanks to replace worn-out equipment. The company that had manufactured the original tanks was asked to quote. A bid of $266 for each tank was submitted. This seemed high to the buyer. He asked for a reduction, which was refused.

Then the buyer asked other concerns to bid. The highest price quoted by the other concerns was $235 for each tank; but the lowest bid was $175 for the two tanks.

This seemed to be wrong. The low bidder was called on the telephone and asked to reconsider his bid. He evidently thought that it was too high; and, accompanied by his superintendent, he made a visit to the prospective customer's plant, surveying the whole job, and then submitted a price of $150 for the two tanks—$75 each.

The buyer became skeptical; he was certain that all the other bids were too high. "Make the two tanks for $125 and the job is yours," he said. The offer was accepted and the two tanks were delivered, obviously at a loss to the maker.

This incident is typical of general market conditions. The buyer can name his own price—sellers are "order mad." Yet, does the purchasing agent deserve any credit for being able to buy at such prices? Is not the reason rather that everyone has lost his head? Has not the time come to call a halt on senseless selling? RAYMOND H. DAUTERICH

Reducing Designing Costs

The cost of designing special equipment is always a problem to the manufacturer. Designing costs can be reduced materially by making use of the services of the consulting and contract designing engineer. While many manufacturers believe that only the men who are familiar with their shop can design their equipment properly, qualified consulting engineers are equally able to analyze shop conditions. Designs are always subject to approval; drafting time can be estimated before the job is started, and the maximum price set. Competition between designing engineers tends to maintain the quality of the work and keep costs on a fair basis.

A consulting engineer who has acquired a reputation for ability is able to keep a force of good men busy the year around. These men are available to the manufacturer at short notice. It saves him the necessity of maintaining an expensive designing department when not developing new work.

In the work done by the consulting engineer, ideas and experience from other industries can often be incorporated. The manufacturer is in a better position to demand efficient designs and accurate work at a fair price.

The general trend in industry seems to be in the direction of employing consulting designing engineers. Wise manufacturers see in that direction the possibilities of reduced cost and increased efficiency. H. W. CABLE

Two Unusual Jobs of Continuous Milling

THE efforts made to secure greater economy in manufacturing are nowhere more apparent than in the automotive field. Many of the outstanding economies effected may be found in the milling departments of this industry, where often operations other than milling have been combined with milling operations, thus reducing the time.

In one large automobile plant, the 3/64-inch diagonal slot on aluminum pistons is cut at the rate of 1600 pistons per hour. Simultaneously with the slotting operation, a spring-loaded hammer mechanism automatically stamps the word "Front" on the head of each piston.

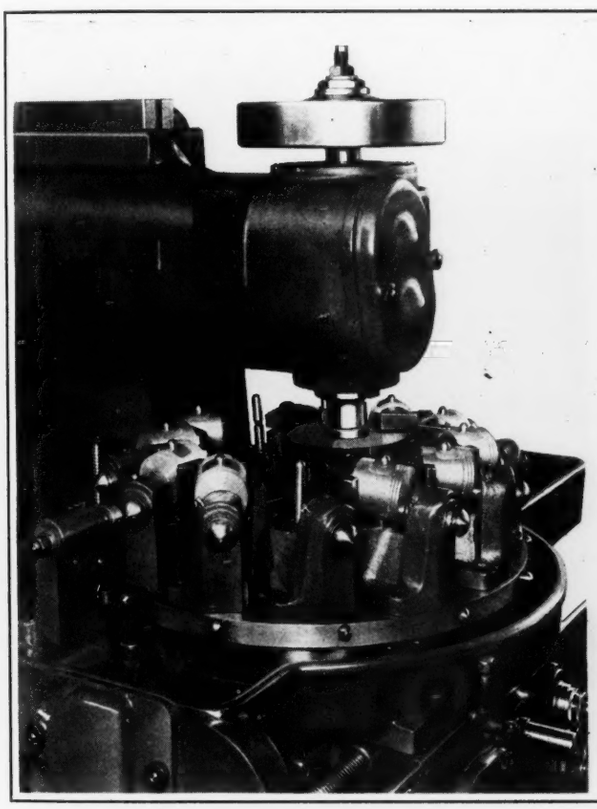


Fig. 1. Continuous Milling Set-up for Slotting Pistons. Note the Automatic Hammer at the Left for Stamping Each Piston

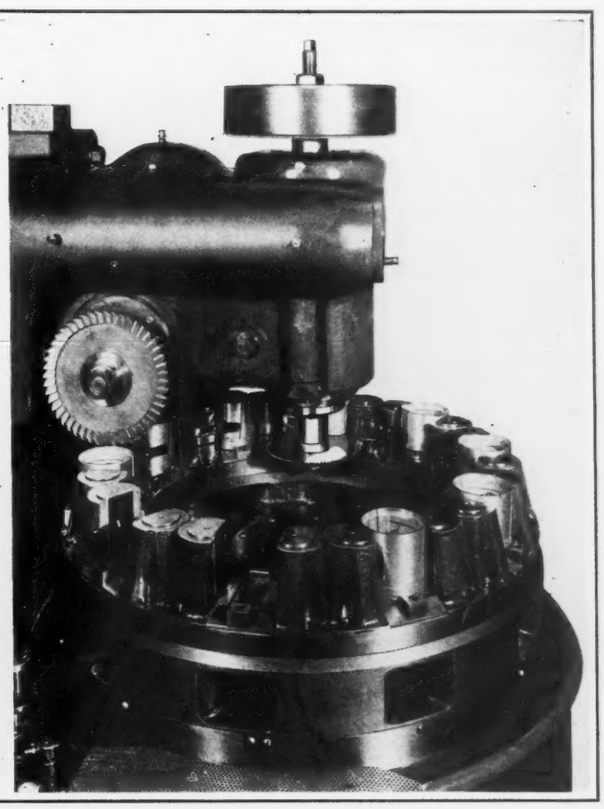


Fig. 2. The Skirt Curve on the Pistons is Milled by a Rotary Movement. The Table Oscillates for Taking a Gash Cut

This job, as shown in Fig. 1, is performed on a vertical rotary Rigidmil, built by the Sundstrand Machine Tool Co., Rockford, Ill. The 24-inch rotary table of this machine is equipped with twelve independent and interchangeable work-holding fixtures. An 8-inch high-speed saw is used for cutting the slot as the table rotates. At the left will be noted the hammer mechanism for marking the piston heads.

Another unusual milling set-up on the same type of machine is shown in Fig. 2. This machine, however, is provided with a two-spindle head and an auxiliary drum-cam for oscillating the table. Here, the same pistons are slotted in the third ring groove and the open end is also milled to obtain the required curvature. Both these operations are performed simultaneously at the rate of 900 pistons per hour. Ten interchangeable fixtures are used.

Previous to this operation, the pistons are turned and grooved, their heads are faced, the wrist-pin holes are bored, and the diagonal slot is sawed. Each piston is loaded into the fixture with its closed end resting on steel plates. The piston is automatically clamped, as the table rotates, by means of two cam-operated fingers which grip the wrist-pin holes. The curvature is formed in the skirt, or open end, by the cutter in the horizontal spindle, and the slot is cut by the saw in the vertical spindle.

In order to mill the slot in the proper location, the gash method of milling is used—hence the oscillating movement of the table. However, to machine the radius on the skirt end of the piston, it was necessary to use the continuous rotating method. The cutters are so arranged and the table so timed that the oscillating motion takes place at the point where the milling cutter in the horizontal spindle is between two pistons. Thus, the oscillating movement has no effect on the skirt milling operation.

Using Two Chucks for Supporting Long Cylinders in a Lathe

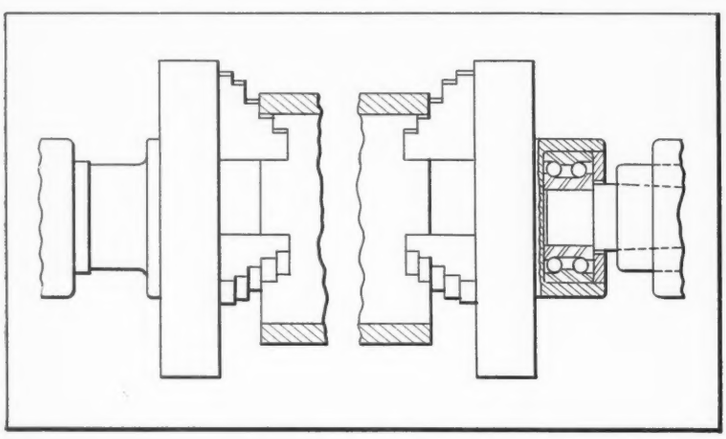
By OSBERT E. CHARLES

The outside cylindrical surface of rolls used in certain types of textile machinery must be entirely free from sand, blow-holes, and similar imperfections; otherwise, cotton or lint will adhere to the surface. The diameter of these rolls ranges from 5 to 12 inches, and the length from 30 to 40 inches. They are made from cast-iron cylinders, in the ends of which are screwed the journal heads.

Formerly, these rolls were machined in a lathe by holding one end of the rough cylinder in the chuck. Near the other end was secured a collar, which was supported in the back-rest. With this set-up, each end was squared, bored, and threaded for the heads. The heads were then assembled and the outside cylindrical surface of the roll turned between centers.

This method, however, proved to be rather expensive, owing to the rejections due to surface imperfections in some of the cast-iron cylinders. To reduce the cost of these rejections, the sequence of operations was changed so that the cylindrical casting surface could be turned first. In this way, any imperfections would be discovered before further work was done on the roll.

The rough cylinder is supported rigidly in the lathe by two three-jaw chucks, as indicated in the illustration. One of these chucks serves as a driver, and is mounted on the headstock spindle. The other chuck is equipped with a ball-bearing adapter having a tapered shank that fits the tailstock spindle. Special chuck jaws were provided. They are stepped so that the cutting tool can pass either end of the cylinder without interference.



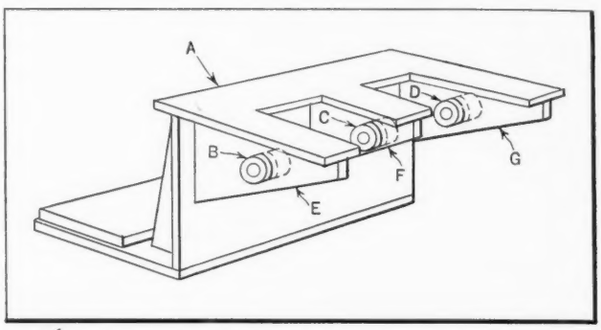
Chuck Equipped with a Ball-bearing Adapter that Fits the Tailstock and Provides a Rigid Support for Turning Long Cylinders

After the cylindrical surface is finished, the right-hand end is supported in the back-rest; the tailstock is then moved back, and the end of the roll is squared, bored, and threaded. The roll is then reversed and the other end finished.

Making Welded Machine Frames with Accurately Aligned Bearings

By A. BEUSCH

Some time ago the writer had occasion to build an automatic rivet-feeding machine with a fabricated frame, such as shown at *A* in the illustration. No suitable machine was available for boring out the bearings *B*, *C*, and *D* and some other means for aligning the bores was therefore necessary. The



Arc-welded Machine Frame with Accurately Aligned Bearings

parts of the structure were cut to shape from steel plate with a cutting torch. The bearing bosses for bearings *B*, *C*, and *D* were turned on a lathe to a diameter of 1 3/4 inches and finish-bored to a diameter of 1 1/8 inches. A hole 1 3/4 inches in diameter was drilled through the members *E*, *F*, and *G* to accommodate the bearing bosses. The frame was then assembled by arc welding.

Before the parts were assembled, a 1 3/4-inch shaft was placed in the holes in *E*, *F*, and *G* to insure accurate alignment of the holes for the bearing bosses. Next, the frame was annealed to remove all strains in the steel. The bosses were then fitted into the members and a 1 1/8-inch shaft was slipped through the bored holes to keep the bosses in position while they were being welded. Further annealing of the work was unnecessary.

After welding the bearing bosses in place, the 1 1/8-inch shaft was removed, and finished bronze bushings were pressed into the bosses. The finished surfaces of the frame were then machined, bringing them into correct relationship with the bearings. Practically perfect alignment of the bushings was obtained in this manner, and a snug running fit for the shaft secured without reaming the bearing bushings. The bearings presented a good appearance, as the bushings were concentric with the outside of the bosses. The process described can be applied with equally good results on machines having several shafts.

The procedure described indicates how arc-welded construction can be applied in many cases to produce results that at first appear difficult to obtain.

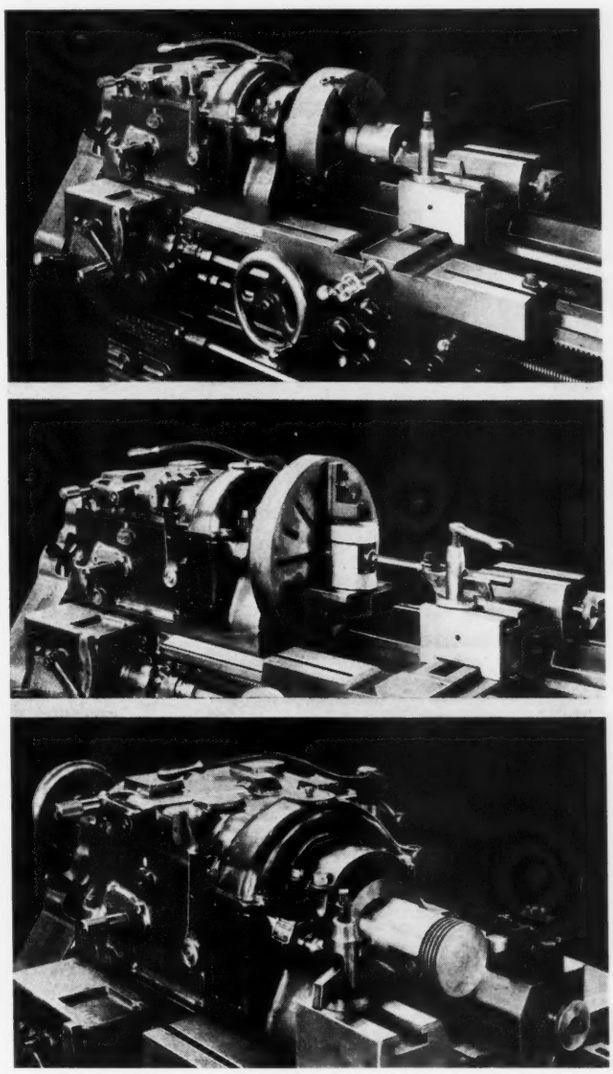
Rapid Machining of Automobile Pistons in an Engine Lathe

Automobile pistons can be machined complete in less than four minutes apiece in an engine lathe provided with the equipment shown in the accompanying illustrations. The first operation consists of boring and facing the skirt while holding the piston in a four-jaw independent chuck, as shown in the upper illustration. The diameter of the bore is held to size by the micrometer dial on the cross-slide lead-screw.

The second operation consists of boring the wrist-pin holes with a fly cutter held in a bar, as shown in the middle view. The pistons are located and clamped in a fixture attached to the faceplate. The angle-plate is so machined that it locates the piston central with the skirt bore. After boring, the wrist-pin hole is reamed with a reamer in the tailstock.

In the last operation (see lower view), the end of the piston is turned and faced with a tool in the front rest and grooved with four tools mounted at the rear of the cross-slide. The pistons are centered by the skirt bore and held on a fixture fitted to the spindle nose. A pin is inserted through the wrist-pin hole and drawn tight with the hand-wheel at the rear end of the spindle, which has a draw-bar arrangement.

Most of the operations are performed with high-speed steel tools at a cutting speed of 310 feet per minute and a feed of 0.008 inch. The grooving operation, however, is performed with Stellite cutters. The Cincinnati Lathe & Tool Co., who built the lathe and equipment illustrated, estimates that the production time can be reduced at least one-third by using tungsten-carbide tools. Also, some reduction in time can be obtained by using air chucks for the first operation and by employing air to manipulate the draw-in attachment in the last operation.



Three Operations on Cincinnati Lathe that Complete the Machining of an Automobile Piston in Four Minutes

Metal Congress and Exposition to be Held in Buffalo

In conjunction with the forthcoming National Metal Congress and Exposition, to be held in Buffalo, October 3 to 7, a number of national engineering societies will hold meetings that promise to present much of interest to the engineer in almost every branch of industry.

Titles of twenty-seven technical papers scheduled by the American Society for Steel Treating have already been announced. Eight other societies will participate in the meeting. The American Society of Mechanical Engineers will hold a meeting of its Machine Shop Practice Division at the Hotel Statler, Monday, October 3, when two sessions will be held—one in the afternoon and one in the evening. Six papers will be presented as follows: "The Influence of Oil Compressibility on Speed Characteristics of Hydraulic High-speed Presses," by Walter Ernst; "The Torque Required to Tap Cast Iron Using National Coarse-thread Series and National Fine-thread Series Taps," by J. E. Miller; "Recent Trends in Machine Tool Design," by Guy Hubbard; "Technique of Size Control in Precision Grinding," by R. E. W. Harrison; "Design of Products to Utilize Die-castings of Machined Parts," by L. H. Morin; "Materials for Modern Cutting Tools," by J. V. Emmons.

The Society of Automotive Engineers will hold a session on the morning of October 3, when two papers will be presented. A motion-picture film of the production of high-grade die-castings will also be shown. The American Welding Society will hold its regular fall meeting with sessions spread over four days. The Metal Exposition will be held in the 174th Regiment Armory during the entire week beginning October 3.

The 1931 Census of Machine Tools

THE Bureau of the Census announces that, according to a preliminary tabulation of data collected, the value of machine tools made in the United States in 1931 amounted to $56,368,822, as compared with $186,373,954 in 1929, the last previous year for which a census was taken. The most important items, as regards total value, for 1931 are as follows: Portable tools (electric and pneumatic drills, grinders, hammers, etc.), $11,486,553; lathes, $9,849,397; grinding machines, $8,249,336; drilling machines, $5,173,646; milling machines, $3,756,758; gear-cutting machines, $3,568,621; presses, $2,384,330; boring machines, $1,914,640; forging machines, $1,240,855; and threading machines (except for pipe), $1,036,213.

Under the definition of machine tools, as used by the Bureau of the Census in arriving at its figures, the machine tool industry embraces plants engaged wholly or principally in the manufacture of that class of power-driven machines generally designated by the term "machine tools," but does not cover the manufacture of certain types of machines designed for working metal, such as sheet-metal working equipment, welding machines, and wire-drawing and wire-working machines.

The statistics for 1931 cover 275 establishments, as compared with 280 in 1929. The average number of wage earners, not including salaried officers and employes, was 21,168 in 1931, compared with 47,391 in 1929. The wages paid by the industry amounted to $25,062,306 in 1931, as compared with $76,410,237 in 1929.

The average number of wage earners reported is higher than the number that would have been required to produce the 1931 output of the machine tool industry had all been employed on a full-time basis. Most of the wage earners reported worked part time; hence the 1931 figure for the number of men employed is correct only in so far as it indicates the average number of men that had employment; but it should be understood that this was not full-time employment.

Production of Machine Tools in 1931 and 1929

Class	1931		1929	
	Number	Value	Number	Value
Machine tools, total value		**$56,368,822**		**[1]$186,373,954**
Made in the industry		54,865,487		[1]176,426,454
Made as secondary products in other industries		1,503,335		9,947,500
Bending machines	940	458,253	2,680	1,583,794
Boring machines:				
Horizontal	68	571,359	159	932,237
Vertical	16	223,614	257	1,363,881
Special types				
Combination boring, drilling, and milling	45	492,298	144	1,467,786
Combination boring and turning	28	362,581	129	1,341,240
Other	[2]	264,788	[2]	[1]1,108,203
Cutting-off machines:				
Band saw	82	49,971	324	194,098
Hacksaw	610	136,998	2,680	642,475
Other, including automatic and cold-saw	97	115,267	[6]181	[6]368,617
Drilling machines:				
Horizontal	[2]	742,227	274	755,997
Vertical				
Multiple-spindle	238	943,309	1,003	4,149,614
Standard	[2]	639,468	3,315	2,022,870
Sensitive				
Single-spindle	844	169,734	2,977	919,734
Multiple-spindle	175	210,769	2,404	2,453,444
Radial	204	630,609	1,317	4,643,310
Combination vertical and horizontal	29	225,890	[2]	2,349,551
Other special, including automatic, bench, and vertical universal head	[2]	1,611,640		
Forging machines	[2]	1,240,855	950	3,066,650
Gear-cutting machines	[2]	3,568,621	2,216	8,979,908
Grinding machines:				
Cutter and tool	346	351,023	2,187	1,574,966
Drill	59	30,739		
External cylindrical				
Plain	425	2,085,484	1,362	6,206,709
Universal	57	140,728	603	1,173,912
Surface				
Horizontal	187	341,677	1,790	3,567,658
Vertical	359	541,248		
Other, including disk, internal, cylinder, and wet grinders	[2]	4,758,437	[2]	[1]9,578,682
Hammers (not portable)	[2]	665,148	[2]	1,594,998
Honing machines	80	218,170	[1]176	[1]588,250
Keyseaters	18	34,324	[2]	94,999

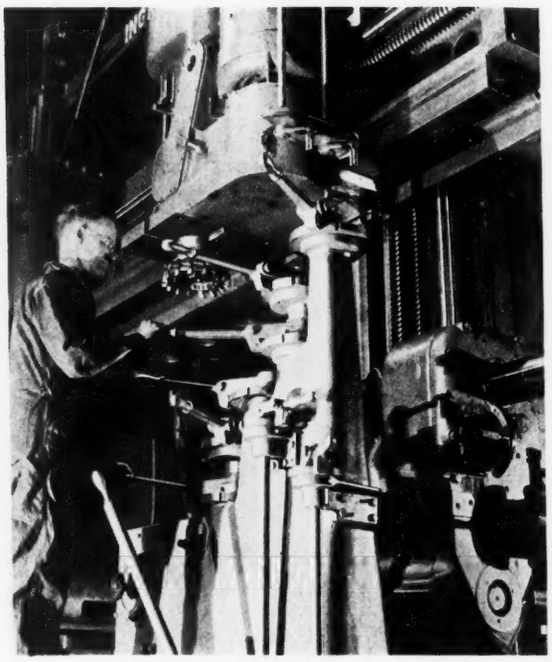
[1]Revised. [2]Data incomplete. [6]Cold saw only.

Class	1931		1929	
	Number	Value	Number	Value
Lathes:				
Bench	(2)	$110,797	(2)	$381,240
Engine				
Capacity 16" swing and under	2,304	1,459,643	6,387	5,402,569
Capacity over 16" swing and including 22"	300	621,638	1,535	3,203,995
Capacity over 22" swing and including 36"	84	229,260	681	2,374,637
Capacity over 36" swing	19	317,401	90	778,269
Polishing and buffing	206	148,623	4,911	1,167,357
Automatic single-spindle				
Bar	201	631,587		
Chucking	253	702,902		
Automatic multiple-spindle			4,737	18,356,038
Bar	192	1,413,212		
Chucking	188	1,950,418		
Turret				
Horizontal hand-operated				
Ram type	219	474,999		
Saddle type			3,132	9,878,132
Standard	110	508,519		
Heavy-duty	47	344,376		
Other	(2)	936,022	1,670	8,011,537
Milling machines:				
Hand-feed	87	41,488	312	129,803
Power-feed				
Automatic	(2)	176,149	(3)	(3)
Plain	354	709,263	1,112	2,759,194
Universal	(2)	666,882	2,270	5,840,142
Vertical	168	616,398	469	1,428,516
Lincoln, including planer type	90	631,910	904	4,216,890
Other	(2)	914,668	600	2,482,024
Planers:				
Standard				
36" and under	18	81,052	62	368,537
Over 36"	11	191,498	57	807,835
Open-side	14	102,434	89	873,105
Special	9	54,124	60	467,764
Pipe cutting and threading machines:				
Number reported	303	309,996	2,933	1,756,564
Number not reported	...	204,372	.....	.....
Portable tools:				
Drills				
Electric				
Number reported	53,744	2,437,787	114,306	4,586,469
Number not reported	.....	54,882	.....	.....
Pneumatic	6,664	1,190,997	[4]19,063	[4]2,446,608
Grinders				
Electric	10,207	539,698	46,360	2,395,279
Pneumatic	3,806	425,491	10,484	1,151,348
Hammers (chipping, riveting, calking, etc.)				
Electric	(2)	119,442	3,739	648,671
Pneumatic	12,011	1,112,099	[4]51,391	[4]2,900,224
Other, including portable motor-driven garage equipment and flexible-shaft machines	.....	5,606,157	(1)	[5]5,638,575
Presses:				
Forming	145	407,431	609	1,756,371
Hydraulic	6	15,281		
Stamping, power	(1)	1,392,635	4,352	6,611,169
Punch	351	294,914	1,638	1,004,324
Other, including arbor, and hand and foot power stamping presses	(2)	274,069	(3)	420,327
Punching machines (not portable)	35	159,382	330	1,111,993
Riveting machines (not portable)	(1)	257,695	(3)	(3)
Shapers, horizontal:				
20" stroke and under	119	191,795	1,044	1,441,239
Over 20" stroke and including 28"	83	160,610	442	855,872
Over 28" stroke	23	91,331	191	506,994
Shears, hand	171	9,977	797	22,696
Shears, power:				
Combination punch and shear	(2)	185,021	488	501,808
Rotary	194	122,349	550	193,591
Straight	199	239,444	753	991,496
Other, including alligator	(2)	65,355	(2)	431,800
Slotters and vertical shapers	105	342,523	292	782,198
Threading machines (except for pipe):				
Die and rolling type	394	436,408	861	1,508,166
Milling type	122	473,005	150	680,432
Tapping machines	(2)	126,800	(2)	603,180
Other machine tools and machine tools not classified	...	3,261,384	...	[1]13,775,393

[1]Revised. [2]Data incomplete. [3]Not called for separately on schedule. [4]Not strictly comparable with figures for 1931: includes data for rock drills, tampers, etc. [5]No comparable data.

Giant Ingersoll Milling Machine

A Milling Machine Weighing 275 Tons that Required Eleven Flat Cars for Shipping



CASTINGS 15 feet wide, 11 feet high, and 40 feet long can be handled by a mammoth milling machine recently built by the Ingersoll Milling Machine Co., Rockford, Ill. This machine is believed to be the largest of its type ever built. The bed is 80 feet long, the over-all height 20 feet, and the weight almost 275 tons.

Four milling heads are provided, two of the vertical type on the adjustable cross-rail, and one of the horizontal type on each housing. Each head is driven by an individual motor, which is independent, reversible, and of the variable-speed type. With this arrangement, it is possible to use a 6-inch cutter on one head and an 18-inch cutter of opposite hand on another head, and employ the proper spindle speeds for each cutter. The machine is equipped with a right-angle boring and milling attachment as well as a high-speed drilling attach-

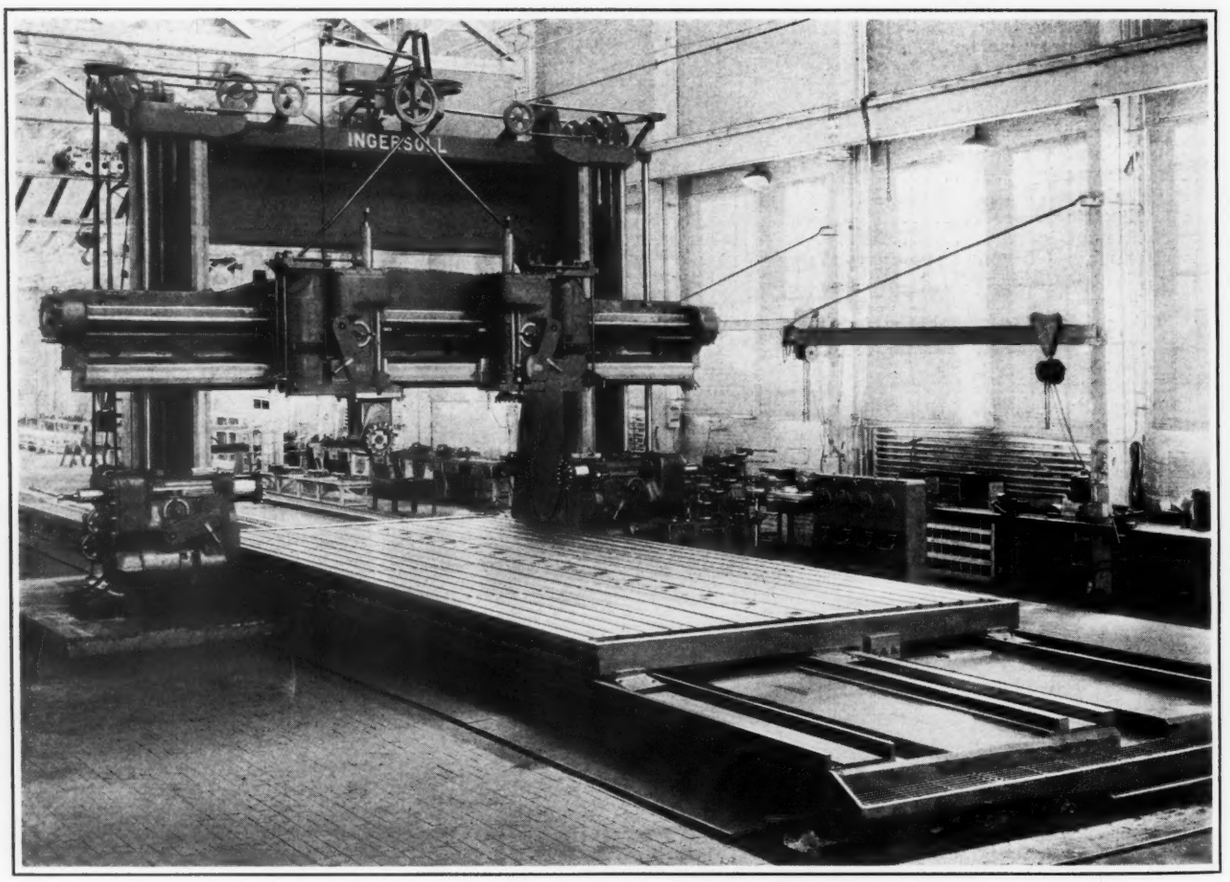


Fig. 1. Milling Machine of Mammoth Proportions Designed to Handle Work up to 15 Feet Wide, 11 Feet High, and 40 Feet Long

ment, which may be applied to either vertical head. All controls are centralized at one station. They are carried in two panels. One panel controls the four drive motors, there being a push-button and rheostat control for each, while the other panel has the feed motor control and all gear-change levers. A pendent switch permits the operator to start, stop, or jog the machine while standing at either side of the table or on top. The ease of control is apparent from the fact that the operator can obtain adjustments of 0.001 inch through the jog-button control.

The feed motor is also independent, and is of the variable-speed type. It provides a feed and rapid traverse in either direction to the table, cross-rail, heads, and quills. Although the feed and rapid traverse to all units are independent of one another, it is possible to set the rate of feed so that it will be the same on all units. The feed mechanism and the table ways are lubricated by independent oil-pumps and Purolators. The cross-rail is equipped with a centralized one-shot lubrication system for all bearings and gears. Forced-feed lubrication is supplied to the heads and their ways. The drive gears are made of chrome-nickel steel, and the heads are equipped with anti-friction bearings. The cross-rail and the horizontal heads are counterbalanced.

Limit switches provide against over-travel of the table, rail, or any of the heads, so that accidents through carelessness of the operator are forestalled. Also, any overload of the drive motors is prevented by an automatic cut-off.

* * *

Wire 0.0004 Inch in Diameter

The tungsten filament wire used in the Westinghouse Mazda six-watt incandescent lamp is so fine that it is almost invisible. It is only 0.0004 inch in diameter. In other words, it takes from eight to ten of these wires to equal the diameter of a hair on a man's head. The wire is coiled, having 1390 turns per inch to form a spring-like filament through which the electricity flows to produce light. The outside diameter of this "'spring" is still less than the diameter of a human hair.

The filament wire is drawn from a bar of tungsten 3/8 inch square and 24 inches long, weighing 1.33 pounds. To produce the wire, it must pass through ninety-five dies; nearly two-thirds of these are diamond dies. The 24-inch-long bar ultimately produces wire 207 miles long, providing filament for more than 666,000 lamps. It takes two weeks of forty-eight working hours each to draw one bar into the finished wire.

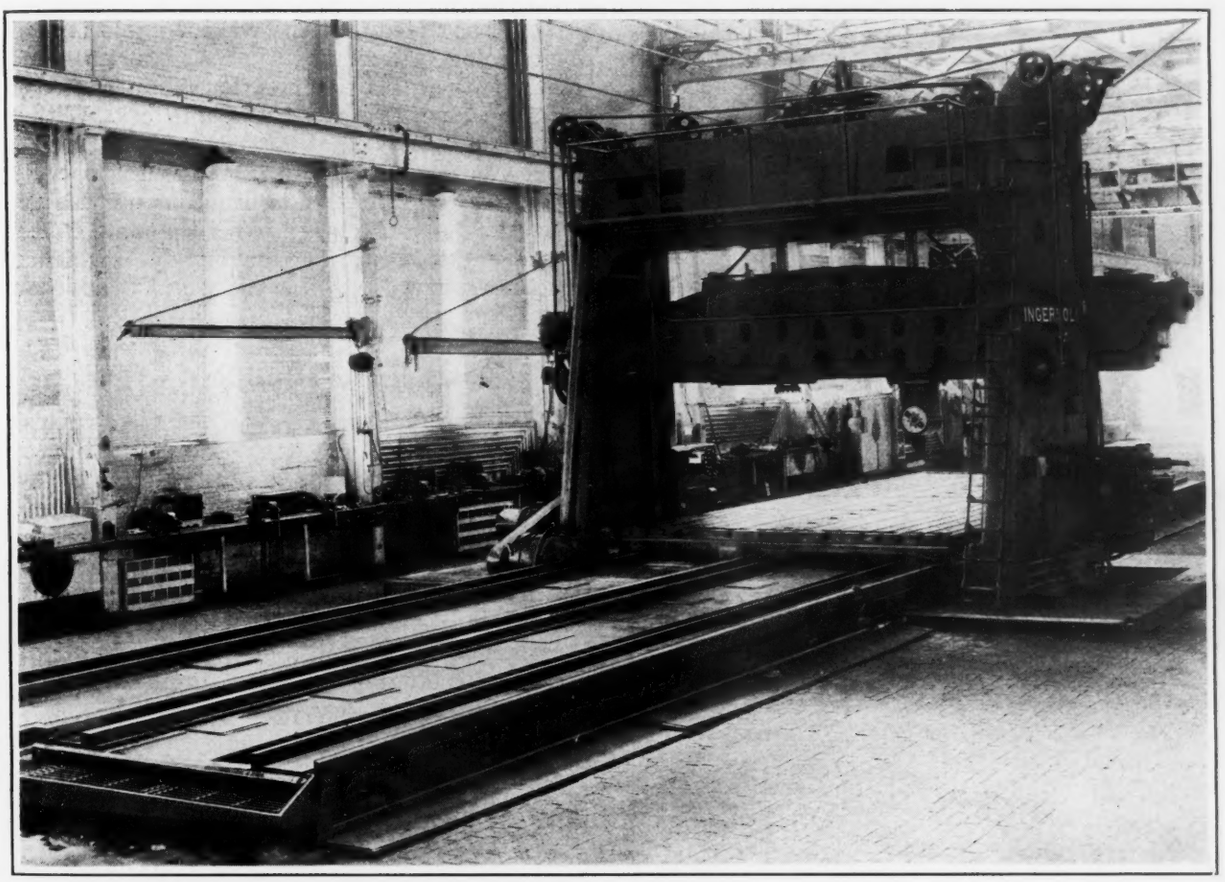


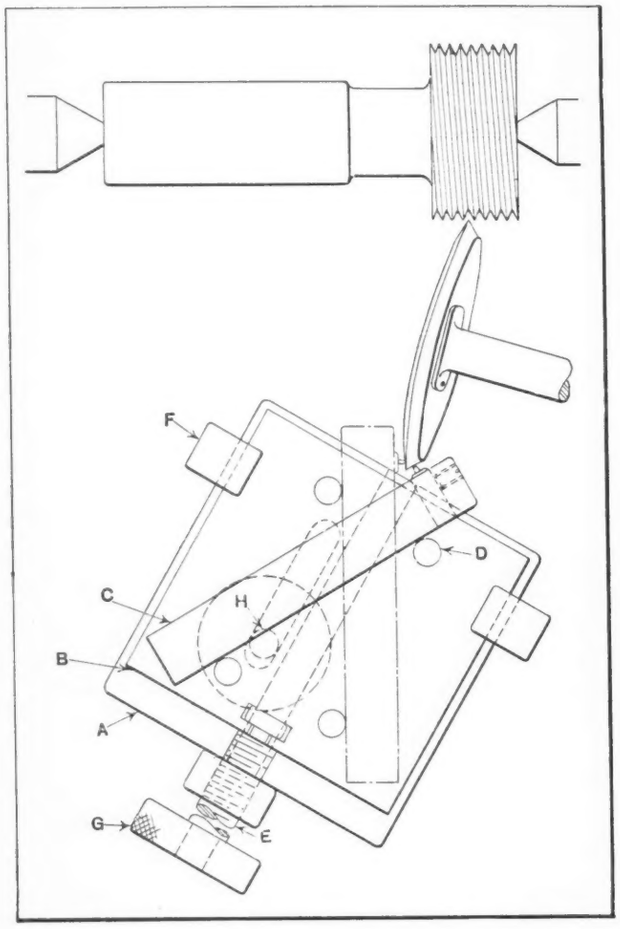
Fig. 2. Rear View of the Huge Ingersoll Milling Machine, which Has a Bed 80 Feet Long

Diamond Truing Device for Thread Grinding

By J. E. FENNO

The method used in one tool-room for truing the grinding wheel accurately when grinding thread plug gages is shown diagrammatically in the illustration. Here the part is held between the centers of an engine lathe, the grinding wheel being shown withdrawn from the thread for truing.

The truing device consists of a bracket *A* secured to the carriage of the lathe. The top of the bracket



Simple Device for Truing Grinding Wheel when Grinding Threads in a Lathe

is machined to provide a bearing for the ground plate *B*, which is guided by a key in a 60-degree path with respect to the center line of the lathe. A bar *C* of rectangular cross-section serves as a holder for the diamond, which is inserted at one end. In use, the holder is laid on the face of plate *B*, in the position shown by the full lines, and is backed up by two of the four pins *D*. These pins serve to guide the holder while truing both angular faces of the wheel.

The holder is fed back and forth by hand while the diamond point trues one angular face of the wheel. To true the other angular face, the bar is turned over and placed against the remaining two pins in the position shown by the dot-and-dash lines. These pins are located in plate *B* so that the included angle to which the wheel is trued will be exactly 60 degrees, or equal to the angle of the thread to be ground.

It is obvious that some provision must be made for moving the plate toward the wheel as the wheel wears. This adjustment is obtained by turning the knob *G* on the screw *E*. This screw is threaded in a block secured to bracket *A*, and is turned down at one end to fit a T-slot in plate *B*. Gib blocks *F*, also secured to bracket *A*, retain the plate against the surface of the bracket. When the plate is adjusted to its final position, it is clamped securely by means of the binding screw *H*.

It will be noted that the wheel-spindle is placed at an angle to the center line of the plug gage. This is necessary to provide clearance for the body of the grinder with respect to the tailstock. With the equipment described, the wheel can be trued between any successive cuts, as the truing operation is very rapid. In designing a fixture of this type, precautions must be taken to set the plate *B* at the proper angle; otherwise the angle to which the wheel is trued will vary as the wheel wears.

* * *

Good News of Business Activity

The Young Radiator Co., Racine, Wis., writes us that its business shows definite signs of improvement. The company has received a large contract for oil-temperature regulators for immediate delivery and is also working on the largest order of parts for car heaters that has ever been on the company's books. Several departments are engaged on a full-production schedule. The engineering and design departments and the tool, jig, and die division are working over-time, in order to meet the required delivery dates.

Another company reporting that there are no signs of depression in its plant is the Kron Co., Bridgeport, Conn., manufacturer of weighing scales. This company has been continually adding to its working force for some time.

Production of boiler units for the new General Electric oil-burning furnace has been stepped up 100 per cent to meet demands, it has been announced by the General Electric Co. at Pittsfield, Mass. All available electrical welders have been recalled for this work.

Manufacturers able to send us similar reports of improvements in business would help in re-establishing confidence by giving such news publicity.

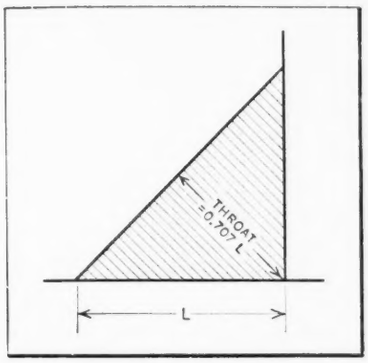
* * *

"Unbridled competition has been one of the major contributing causes of the economic depression. . . . The people of the United States are now confronted with an emergency more serious than war. . . . Misery is widespread in a time, not of scarcity, but of abundance."—*Justice Brandeis, of the United States Supreme Court.*

Fillet Sizes for Arc-Welded Construction

By ROBERT TWEEDSIDE

The substitution of welding for riveting cannot be done properly in the ordinary welding shop without the guidance of experienced engineers. Riveted structural designs have been developed by many years' experience. Proper consideration of the stresses involved is necessary. Elementary information on the unit strength of welds in shear should be used with caution, and while such information is safe in the hands of experienced engineers and designers, its blind use by those who are not properly informed may prove disappointing.



Cross-section of 45-degree Arc-welded Fillet

However, changes can be safely made in the fastenings of jigs, fixtures, and machine repair work, where any error is almost certain to be on the side of safety. When welding is used for right-angle connections, there is a tendency to make the fillet longer than is necessary, considering the loading requirements. A rivet, bolt, or screw can usually be replaced by a short length of welded fillet. It is common practice, however, to weld all around the edges to be joined, although short properly spaced fillets would suffice.

The accompanying table gives the lengths of arc-welded fillets of triangular section that are equivalent to various diameters of hand-driven rivets or unfinished bolts. A glance at this table will show, for example, that two properly located 3/8-inch fillets, each about 1 3/8 inches long, can be used to replace two 1/2-inch cap-screws as a fastening between two pieces of steel. The table is intended primarily for use in the shop, while the following notes and the diagram have been prepared for use in the drafting-room.

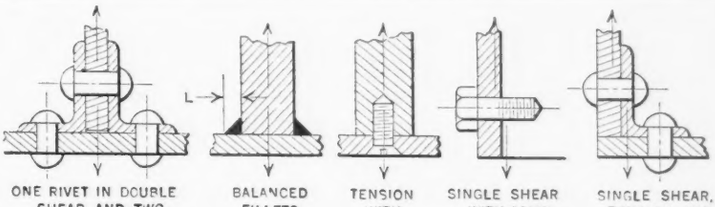
Things to Remember About Arc-Welded Fillets

The weld material is weaker in shear than in tension or compression. When tested to destruction, good fillet welds always break across the minimum section through the corner, irrespective of the direction of the loading, because the maximum shear stress occurs on planes at 45 degrees to the direction of the principal stresses. Hence, the safe loads on welded triangular fillets are calculated on this weakest section, called the throat as indicated in the accompanying illustration. Using a factor of safety of about 4, the accepted safe values for welded material are: Shear, 11,300 pounds per square inch; tension, 13,000 pounds per square inch; and compression, 15,000 pounds per square inch.

In a 3/8-inch fillet, the minimum or throat dimension equals $0.375 \times 0.707 = 0.266$ inch, and the shear equals $11{,}300 \times 0.266 = 3000$ pounds per linear inch. This gives a convenient and safe working value of 1000 pounds per 1/8 inch of nominal size of fillet per linear inch of weld. This value has been well established by numerous tests. If designed to carry the shear load safely, the fillet will be amply strong in tension or compression. Secondary stresses due to eccentric loading should be avoided by a balanced arrangement of welding, so that no allowance need be made for the bending couple formed by the resultant stresses on the two sides of the weld.

As rivets and bolts in single shear may involve eccentric loading, with consequent secondary

Safe Loads on Arc-Welded Triangular Fillets, Hand-Driven Rivets, and Unfinished Bolts


L
ONE RIVET IN DOUBLE SHEAR AND TWO RIVETS IN TENSION WITH CENTRAL PULL
BALANCED FILLETS WITH CENTRAL PULL
TENSION WITH CENTRAL PULL
SINGLE SHEAR WITH SOME ECCENTRIC PULL
SINGLE SHEAR, TENSION, AND ECCENTRIC PULL

Rivet Diameter, Inch	Load W in Double Shear, Pounds	Size L of Arc-welded Fillet, Inch					
		1/4	5/16	3/8	1/2	5/8	3/4
		Load per Inch of Length, Pounds					
		2000	2500	3000	4000	5000	6000
		Length of Arc-welded Fillet Required to Carry Load W					
7/16	3006	1 1/2	1 1/4	1	3/4	5/8	1/2
1/2	3930	2	1 5/8	1 3/8	1	7/8	3/4
5/8	6140	3 1/8	2 1/2	2 1/8	1 5/8	1 1/4	1 1/8
3/4	8840	4 1/2	3 5/8	3	2 1/4	1 7/8	1 1/2
7/8	12,030	6	4 7/8	4	3	2 1/2	2
1	15,710	7 7/8	6 3/8	5 1/4	4	3 1/8	2 5/8

The safe load per linear inch of weld in tension, compression, or shear is taken as 1000 pounds per 1/8 inch of nominal fillet size.

The safe load per square inch of rivet or full bolt area is taken as 10,000 pounds in single shear and 20,000 pounds in double shear. As rivets or bolts in single shear may involve eccentric loading, the lengths of weld for double shear given here should be used for single shear also.

stresses in addition to those due to direct loading, it is well to use lengths of weld equivalent to rivets in double shear when substituting welding for single shear cases. Other things being equal, the unit strength of a good small fillet is measurably greater than that of a larger one. On the other hand, a flaw in a small fillet may cause a greater proportional weakening than in a larger fillet.

* * *

The Engineers Club of Philadelphia is conducting a free employment service for engineers through the Philadelphia Technical Service Committee at 1317 Spruce St., Philadelphia, Pa. Almost 1000 technically trained men are now on the records of this committee, open for engagement. Of those registered, 78 per cent are graduates of colleges in the United States, 12 per cent are graduates of foreign colleges, while 10 per cent have acquired their engineering training outside of college. It is of interest to note that over one-third of those seeking employment are under thirty years of age, while another third are between thirty and forty years of age.

Belt Conveyor for Carrying Work from One Machine to Another

By S. A. McDONALD

One of the big problems in the manufacture of sheet-metal goods, especially parts that are flat, is to provide sufficient storage space. If the plant is located in a city, where floor space rates are high, it is important that the stock be made into finished goods without unnecessary handling or delay. In making such articles as the polish box shown at *A*, Fig. 1, we have a condition where this is especially important, owing to the bulky nature of the part and the fact that over 30,000 boxes are made in one day. If a delay occurs after the flat lithographed tin sheets are punched and drawn into finished cups, the product may accumulate so rapidly that it may be necessary to stop the presses for lack of storage room.

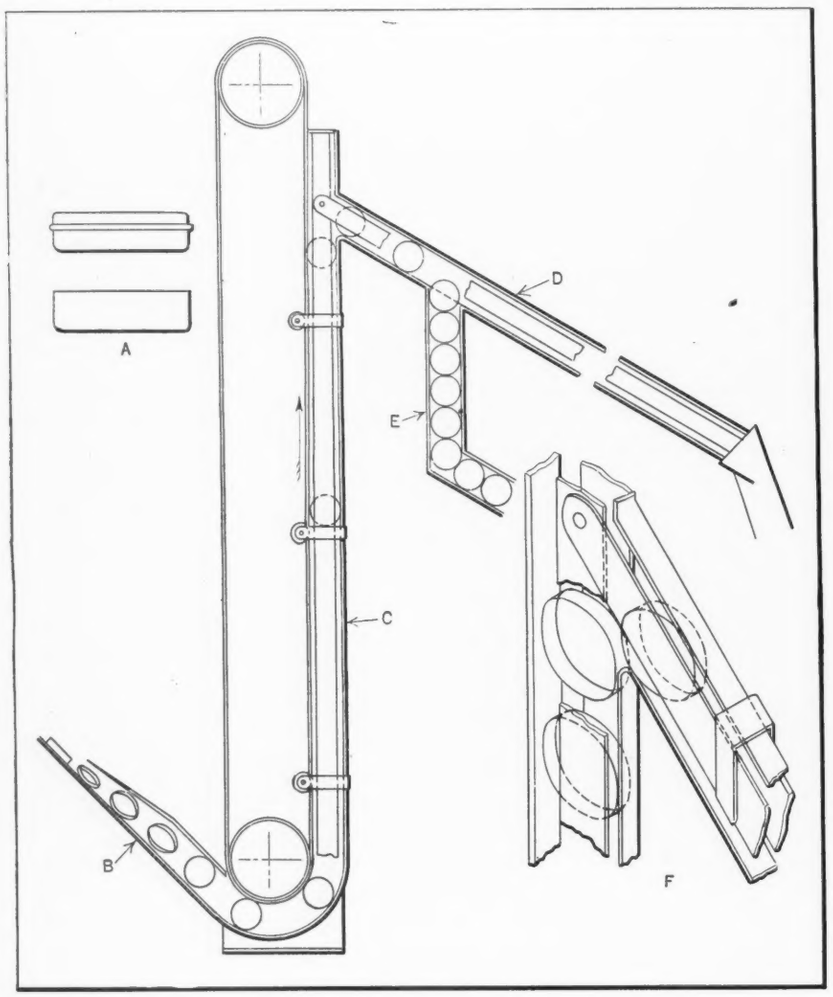


Fig. 1. Details of Carrier System for Transferring Boxes A from One Machine to Another

For this reason and to avoid unnecessary handling, it is advantageous to make such operations automatically continuous, in the manner illustrated in Fig. 2. Here the blanked and drawn boxes are discharged through a chute at the back of the press into a guide channel *B*, which has a 90-degree twist. This twist in the channel turns the boxes on their sides so that they roll down under the pulley and belt of the conveyor. This belt, which is driven from the lineshaft overhead, forms one side of the guide channel and presses the box against the opposite side of the channel, so that it is carried up the vertical channel *C*, shown in Figs. 1 and 2. When the box is opposite the opening for the channel guide *D*, which branches down at an angle of 30 degrees, it rolls down by gravity and drops into the guide *E*, leading to the first beading machine. Here the box is beaded, as shown in the upper view at *A*, and discharged into the basket under the machine.

As the press runs at a higher speed than the beading machine, a second beading machine is set up directly behind the first and the inclined channel guide is continued to feed the latter machine. When the channel guide to the first machine is full, the additional boxes coming down the inclined channel guide, roll over the top box and down to the second machine. An enlarged view of a junction in the channel guide is shown at *F*, Fig. 1. The press tender, whose duties are to supply the operator

with sheet tin and to remove the scrap, also attends to the beaders and frees them or the channel guides from any chopped or mutilated boxes that may come from the press.

* * *

Progress of Russian Industries

The tool and assembly shops at the works in Nijni Novgorod for the manufacture of milling machines have recently been completed, and the Fraser Works for the manufacture of small cutting tools have gone into production. The Fraser Works comprise one main single-story building of approximately 300,000 square feet floor area, with several auxiliary buildings. This plant is intended for the production of drills, reamers, milling cutters, taps, dies, and chasers, as well as other metal-cutting tools. In all, 1690 machine tools have been installed in this plant, the machines being mainly of German manufacture. The plant is designed for an annual production of 10,000,000 twist drills, 700,000 reamers, 700,000 milling cutters, 2,500,000 taps, and 900,000 dies and chasers. One thousand four hundred and forty sizes of tools will be produced.

Photo-Electric Eye for Industrial Use

The use of photo-electric equipment in industry will doubtless be accelerated by the introduction of photo-electric cells especially intended for industrial purposes. One of these has been developed by the G-M Laboratories, Inc., 1731 Belmont Ave., Chicago, Ill. It is known as the Foto-Switch; through its use any kind of electrical device such as a motor, a signal or alarm, or an electric sign can be controlled by means of a light beam.

The Western Electric Co., 50 Church St., New York, has also developed a photo-electric cell outfit which is suitable for many applications, such as counting, checking and inspection, rejection of imperfect samples, regulating production, fire protection and alarms, smoke indication, and actuating mechanical starters, etc.

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During the first six months of this year, the Soviet Union built 452 locomotives, compared with 387 in the same period last year. This output fell somewhat short of the plans, which called for 568 locomotives in the period referred to.

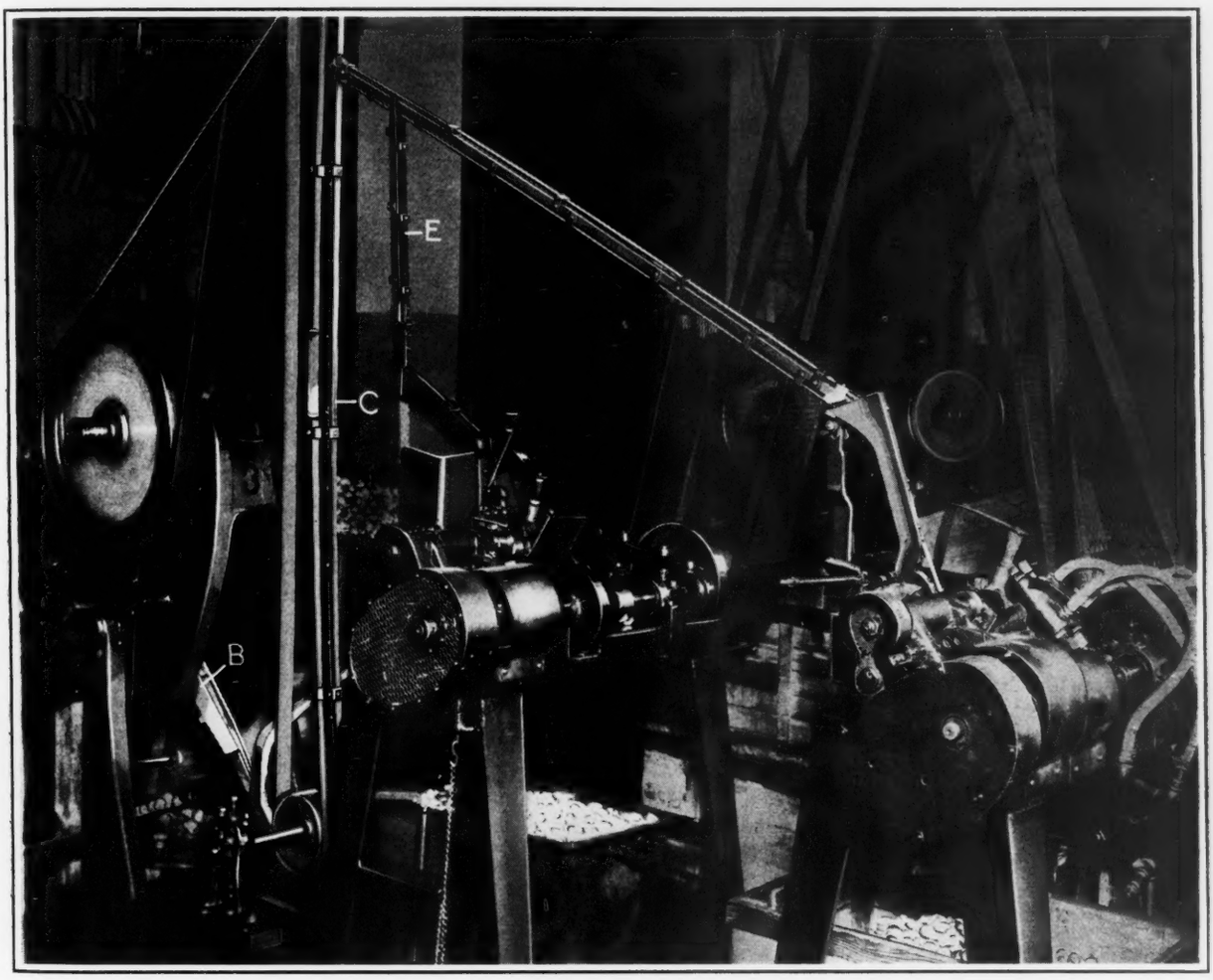
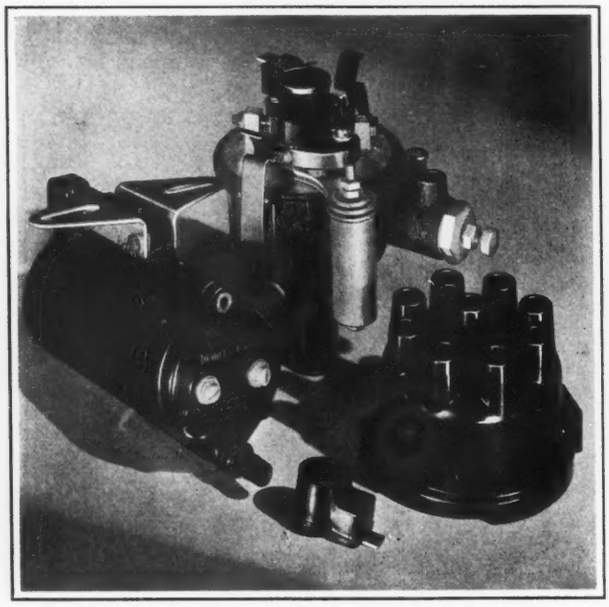


Fig. 2. Installation of Belt Conveying System Illustrated in Fig. 1

Plastic Materials Used for Ignition-System Housing

The increasing use of plastic materials for all kinds of purposes in the design of machinery and machine parts is generally appreciated. One of the recent applications of plastic materials is for the housing or case of an ignition system. Vacuum-timed ignition that regulates the spark-timing in accordance with the engine load, as well as the speed, is one of the features of an ignition system recently developed by the Mallory Electric Corporation. The case or housing used for this ignition system is made from a molded plastic material. The entire ignition coil is housed and hermetically sealed with rubber gaskets in a black case molded from black Durez, a phenol-formaldehyde molding compound. The cover carrying the three terminals is molded of a special type of phenolic compound of high dielectric and arc-resisting qualities. The use of the molded plastic case instead of a metal one eliminates choking and short-circuiting, and prevents moisture from getting into the windings.



Parts of a New Ignition Having Casings or Housings Made from Plastic Materials

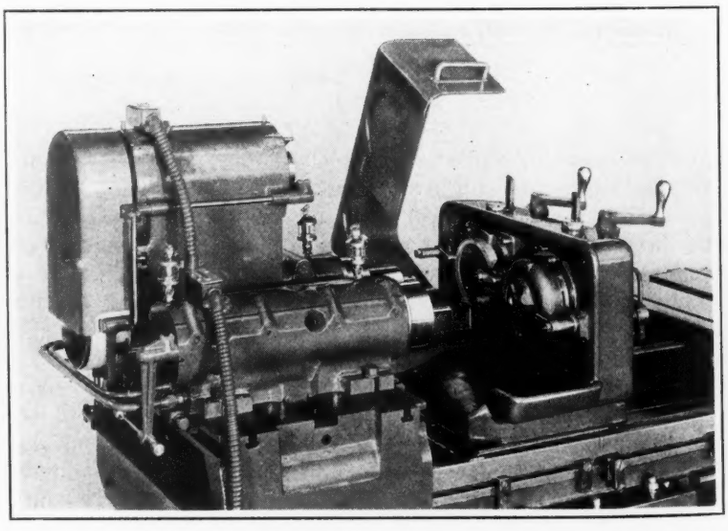
* * *

Chapmanizing—a New Casehardening Process

An entirely new process known as "Chapmanizing," which lends itself particularly to the casehardening of the low-carbon and cheaper grades of steel, thereby eliminating, in many instances, the necessity for using expensive steels and elaborate heat-treatments, has been developed by the Chapman Valve Mfg. Co., Indian Orchard, Mass. By applying this process to low-carbon steel, an almost glass-hard surface is obtained. This hardness penetrates to a reasonable depth, so that the surface is extremely hard even after grinding. The degree of hardness and the depth of the case can be regulated to suit the requirements of each job. The time required for the operation is reduced considerably, as compared with other casehardening methods, and the cost is moderate. The manufacturer who developed this process is in a position to caseharden work by this method for other manufacturers.

* * *

Give people of foreign countries an opportunity to exchange their products in payment for purchases from the United States, and you will restore work opportunity for American labor. In the final analysis, human energy, as represented in goods or services, is the only thing really exchanged between people of different countries. With the prevailing scarcity of gold in most foreign countries, industry and agriculture in this country cannot expect to find markets for their products abroad unless the nation as a whole is prepared to accept commodities and manufactured products in payment.—*George F. Bauer,* Export Manager, National Automobile Chamber of Commerce.



The illustration shows an Ex-Cell-O precision boring machine arranged for boring the steel center of Bakelite laminated timing gears and the bronze bushing of motor frames. Two different gears are handled through the use of separate adapters. In one gear, the hole is bored to a diameter of 2 5/8 inches, and in the other gear, to a diameter of 7/8 inch, while the bushing hole in the motor end frame is machined to a diameter of 5/8 inch. The gears with the small hole can be bored simultaneously with the motor end frame, as illustrated, the production in this case being about 112 pieces per hour. The gears with the large hole are handled at the rate of approximately 72 gears per hour.

NEW TRADE LITERATURE

INDUSTRIAL FURNACES. W. S. Rockwell Co., 50 Church St., New York City. Bulletin 339, containing information on improved methods of heating and cooling wire products. The data are applicable to the heat-treatment of almost any metallurgical, ceramic, or chemical product in almost any type of fuel or electric furnace. Circular 340, outlining the advantages of Rockwell continuous furnaces for bright annealing, bright silver soldering, and bright copper brazing.

ROLLER BEARINGS. Hyatt Roller Bearing Co., Newark, N. J. Bulletin 100, entitled "Dimensions and Load Rating Tables of Hyatt Roller Bearings and Their Application." This bulletin, which contains forty-eight 9-by-12 pages, gives much detailed information pertaining to the use, application, mounting, and lubrication of roller bearings. Typical mountings are illustrated in detail by numerous line engravings.

THREADING MACHINES. Landis Machine Co., Inc., Waynesboro, Pa. Bulletins illustrating and describing Lanco die-heads for automatic, semi-automatic, and hand-operated threading machines, and Landmaco threading machines, Landis standard threading machines, Landis automatic forming and threading machines, and Landis chaser grinders.

ROLLED AND FORMED SECTIONS. Truscon Steel Co., Youngstown, Ohio. Handbook No. N-20, containing data on rolled and formed sections of steel, aluminum, duralumin, and other commercial metals, for manufacturers and for the architectural and building trades. The book is completely indexed for handy reference.

SPEED REDUCERS. Winfield H. Smith, Inc., Springville, Erie Co., N. Y. Catalogue 27, describing in detail many recent additions and improvements in the line of speed reducers and transmission machinery made by this company. The catalogue is made with a tab index so that it can be conveniently referred to.

Recent Publications on Machine Shop Equipment, Unit Parts, and Materials. Copies Can be Obtained by Writing Directly to the Manufacturer, Mentioning MACHINERY.

GRINDING MACHINES FOR TUNGSTEN-CARBIDE TOOLS. Tool Metals Co., 439 E. Fort St., Detroit, Mich. Circular illustrating and describing the No. 100 grinding machine for tungsten-carbide tools. Circular descriptive of a full universal vise for use on surface grinding, milling, and drilling machines.

ELECTRIC EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletin GEA-1586, descriptive of electric equipment for woodworking. Circular GEA-1619, illustrating and describing G-E splash-proof motors of the squirrel-cage induction type. Bulletin GEA-1628, on squirrel-cage motors.

WIRE CLOTH. Newark Wire Cloth Co., Newark, N. J. Catalogue 32, comprising a handbook on the selection and testing of wire cloth, including woven wire screens, metallic filter cloth, testing sieves, foundry riddles, etc. One of the features of the book is a glossary of wire cloth terms.

GRINDING WHEELS. Norton Co., Worcester, Mass. Circular listing the grinding wheels that should be used for various classes of service, such as snagging, cylindrical and internal grinding, tool-room grinding, surface grinding, machine shop grinding, cutting off, etc.

PRESSED-STEEL PRODUCTS. Truscon Steel Co., Pressed Steel Division, Cleveland, Ohio. Bulletin entitled "A Pictorial of Truscon Facilities and Pressed Steel Service," illustrating various steps in the production of pressed-steel parts, as well as typical examples of pressed-steel work.

ELECTRICAL EQUIPMENT. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Leaflet L-20 554, illustrating and describing heavy-duty time-starters applicable to the operation of fans, blowers, pumps, machine tools, and cranes in circuits that may be subject to wide fluctuations of voltage.

ELECTRIC FURNACES. Westinghouse Electric & Mfg. Co., Mansfield Works, Mansfield, Ohio. Leaflet L-20 548, illustrating and describing an electric belt-conveyor furnace. This is a general-purpose furnace for assuring uniform and economical heat-treatment of small and medium-sized parts.

PLASTIC MATERIALS. General Plastics, Inc., North Tonawanda, N. Y. Circular descriptive of the properties and uses of Durez, a plastic molding compound. Bulletin entitled "New Materials for Old," outlining a wide variety of applications of Durez and other plastic molding materials.

FLEXIBLE SHAFTING. Dallett Co., 165-189 W. Clearfield St., Philadelphia, Pa. Bulletin 2430, illustrating and describing the Portflex—a portable device for grinding, disk-sanding, buffing, drilling, wire-brushing, and polishing. Bulletin 2630, describing flexible-shaft drive sanders.

SURFACE GRINDERS. Berea Machine & Tool Works, 320-324 Beech St., Berea, Ohio. Catalogue illustrating and describing the company's grinders, vises, index centers, and magnetic chucks. Also, leaflet illustrating and describing cutters for sizing the recesses for ball bearings.

ABRASIVE-DISK HOLDER. Dallett Co., 165-189 W. Clearfield St., Philadelphia, Pa. Bulletin 2530, illustrating and describing the Springflex pad—a non-chattering abrasive-disk holder, especially adapted for heavy-duty flat surface sanding and grinding operations.

COLD STRIP REELS. United Engineering & Foundry Co., Pittsburgh, Pa. Catalogue covering cold strip reels for reeling, coiling, winding,

blocking, rewinding, and uncoiling cold-rolled metal strip, from flat wires and narrow ribbons up to the widest sizes.

OPTICAL INSTRUMENTS FOR ANALYZING METALS. Bausch & Lomb Optical Co., Rochester, N. Y. Catalogue descriptive of optical instruments for examining and analyzing metals, and their application for laboratory and industrial use.

TUBES AND PIPE. Babcock & Wilcox Co., 85 Liberty St., New York City. Bulletin entitled "Four to Six Per Cent Chromium Steel Tubes and Pipe," giving information on recommended uses and complete technical and physical characteristics.

INDUSTRIAL RUBBER GOODS. B. F. Goodrich Rubber Co., Akron, Ohio. Condensed catalogue containing engineering data designed to serve as a guide in the selection of industrial rubber goods, including belting, hose, and other products.

PACKING BOXES. National Metal Edge Box Co., Callowhill at 12th St., Philadelphia, Pa. Catalogue entitled "The Improved MetalEdge Method of Packaging," illustrating and describing the metal edge type of box for shipping purposes.

LIFTING MAGNETS. Electric Controller & Mfg. Co., 2700 E. 79th St., Cleveland, Ohio. Bulletin 900, illustrating and describing lifting magnets for a variety of industrial purposes, including much new and improved equipment.

MEASURING INSTRUMENTS. Van Keuren Co., 12 Copeland St., Watertown, Boston, Mass. Circular M-30, illustrating and describing light-wave micrometers for rapid and accurate precision measurements.

VACUUM PUMPS. Roots-Connersville-Wilbraham, Connersville, Ind. Bulletin 21-B22, covering the application of R-C-W vacuum pumps to the priming of centrifugal pumps, especially of large size.

SHEET-METAL-WORKING MACHINES. Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y. Bulletin 79, illustrating and describing Niagara lever punches and lever shears.

BEARINGS. Federal-Mogul Corporation, Detroit, Mich. Folder illustrating and describing the Wyromatick compensator, a device used for automatic maintenance of bearing adjustments.

WELDING MACHINES. Lenney Machine & Mfg. Co., Warren, Ohio. Catalogue illustrating and describing welding machines of different types, including spot, butt, and automatic welders.

ELECTRIC EQUIPMENT. Wagner Electric Corporation, 6467 Plymouth Ave., St. Louis, Mo. Loose-leaf bulletin descriptive of Wagner air-cooled transformers and their applications.

BALL BEARINGS. New Departure Mfg. Co., Bristol, Conn. Loose-leaf circular No. 199 FE, illustrating the application of ball bearings to the work-spindle of internal grinders.

CASEHARDENING. Chapman Valve Mfg. Co., Indian Orchard, Mass. Leaflet briefly describing a new process for hardening low-carbon steel, known as "Chapmanizing."

RIVET SETS. Dallett Co., 165-189 W. Clearfield St., Philadelphia, Pa. Bulletin 3231, illustrating and listing rivet sets. Bulletin 3231-A, describing rivet set redressers.

WELDING. Hedges-Walsh-Weidner Co., Chattanooga, Tenn. A series of four pamphlets entitled "History of Developments in the Art of Welding Ferrous Metals."

GAS ELECTRIC SETS. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Bulletin C-1959, covering gas electric sets for every application.

CHISELS. Dallett Co., 165-189 W. Clearfield St., Philadelphia, Pa. Bulletin 2931, illustrating and listing metal-working chisels.

STRUCTURAL ALUMINUM. Aluminum Co. of America, Pittsburgh, Pa. Supplement to the structural aluminum handbook.

Do You Know

how more than 700 different Bakelite materials are solving problems in present-day machine design?—see page 25.

that arc welding is now being applied to ordnance materials and is being used successfully in such important work as gun-carriage construction?—see page 32.

that railroad cars for handling ore and coal are now being built from aluminum?—see page 17.

what effect nickel has on cast iron and what results have been obtained by using nickel-alloy castings in machine construction?—see page 1.

how to prevent damage to machinery shipped by rail?—see page 6.

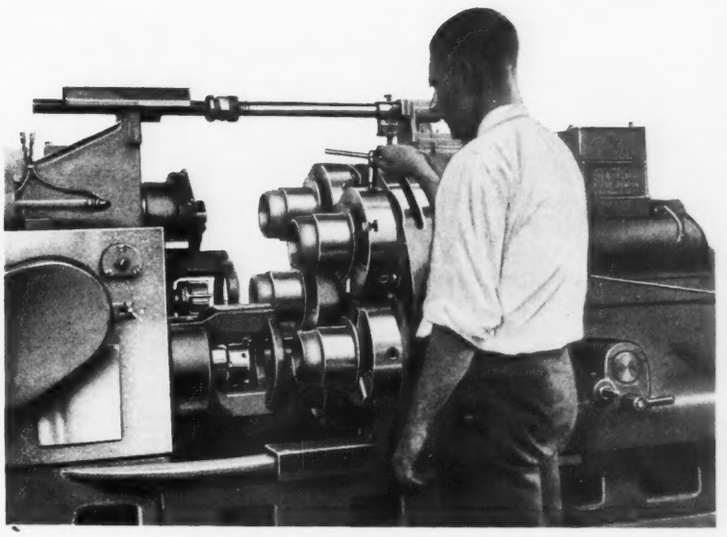
how to determine the fillet sizes for arc-welded construction?—see page 57.

what Lo-Ex alloy is, how it is used, and how it can be machined?—see page 10.

what the characteristics of the Carbonol process are and how it is being applied in heat-treatment processes?—see page 41.

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts and Material-Handling Appliances Recently Placed on the Market



Goss & DeLeeuw Duplex Multiple-Spindle Chucking Machines

Multiple-spindle chucking machines so designed that the tools and chucks can be operated in various combinations to suit conditions are being introduced on the market by the Goss & DeLeeuw Machine Co., New Britain, Conn. All the tools and chucks can revolve simultaneously; all tools can revolve and the chucks remain stationary; all chucks can revolve and the tools remain stationary; or the chucks and any number of tools can revolve simultaneously, while the other tools remain stationary. Two cross-slides are provided.

These machines, to which the trade name of "Duplex" has been given, because of the principle on which they are designed, supplement the line of four-spindle tool-revolving machines built by the concern in 6- by 6 3/4-inch, 8 1/2- by 8-inch, and 11- by 10-inch sizes. They are basically the same in design, with the exception that a different faceplate is provided for carrying the revolving chucks and two cross-slides have been added. The same fool-proof construction is retained and the tool-spindles and their drive remain the same, as does also the heavy turret, with its integral cam feed.

The chuck spindles are mounted in large anti-friction bearings (either ball or tapered roller) in the deep faceplate, and are driven from a separate motor. Each chuck, as it is indexed into the loading position, is automatically thrown out of engagement with its drive and stops to enable the operator to remove the finished piece and replace it with a rough piece. The chuck automatically resumes rotation as it is indexed out of the loading position. Positive tooth clutches control the rotation of the chuck. Because of this design, there is no need of making adjustments to compensate for slippage or wear. Change-gears provide a wide range of chuck speeds.

The cross-slides are located in the first and third tooling positions. They are supported on the broad turret ways of the ma-machine, and are operated by the movement of the turret-slide. The smallest of these "Duplex" machines, the 6-by-6 3/4-inch size, has a maximum feed stroke of 6 3/4 inches and will swing a piece 6 inches in diameter. The largest size—the 11-by-10-inch—has a maximum feed stroke of 10 inches and will swing a piece 11 inches in diameter. If the machines are used as purely tool-revolving machines, larger pieces of work can be handled. The illustration shows a close-up view of the 11-by 10-inch size.

The possibility of revolving both the tool and work is especially advantageous in machining certain jobs that require extreme accuracy, especially when deep holes must be drilled and bored with precision. When a finish-turning operation is to be performed, the fact that a particular spindle can be locked while the others revolve becomes especially important.

Reed-Prentice Horizontal Milling or Routing Machine

A machine that is especially designed for routing the rings of munition shells, but is equally adaptable to other classes of horizontal milling of the interrupted-groove type, is shown in the illustration. This machine has been placed on the market by the Reed-Prentice Corporation, Worcester, Mass. It is equipped with a power-driven work-head and spindle, the latter being supplied with a collet chuck for holding the cutter. The rotary work-head is provided with an automatic feed, there being an adjustable stop that permits the feed to be disengaged at any predetermined point. A motor of ball-bearing type, which operates at a speed of 1200 revolutions per minute, provides the power. It is furnished with a push-button control. Hand rotation of the work-head is available through the handwheel.

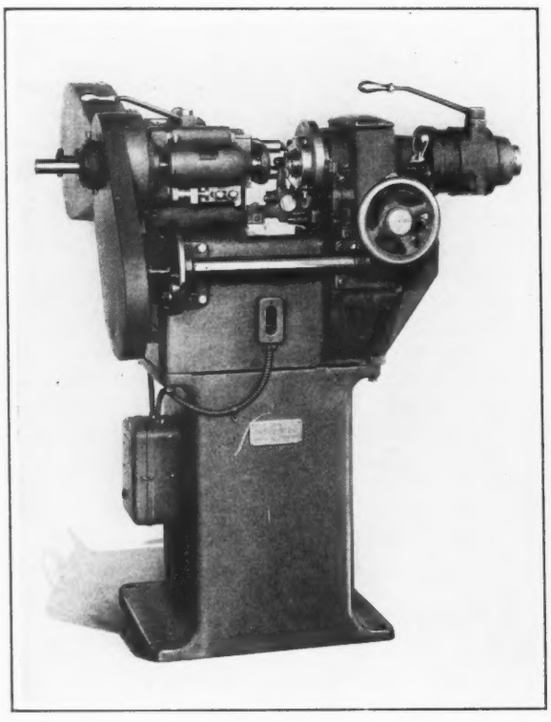
In the operation of this machine, the cutter-spindle runs continuously, speeds of 4000, 4500, 5500, and 6000 revolutions per minute being available. The operating cycle consists of moving the lever on the work-head to grip the shell in the collet type of chuck and then advancing the sliding spindle head by means of a lever to position the cutter for the proper depth of cut. This position is controlled by means of a micrometer adjustment. The rotary feed of the work-head fixture is next engaged through a plunger type of lever.

At the end of the cut, an adjustable stop on the rotating fixture disengages a latch, and the sliding spindle head then automatically withdraws from the cut. The work is removed while the work-fixture is revolving to the starting position for the next piece. When the fixture reaches that position, a dog automatically stops the feed. The cutter-spindle is guarded while the operator is loading and unloading the fixture. One man can tend two machines, the production per machine with 21-second rings, being as high as 160 pieces per hour. The machine weighs approximately 1190 pounds.

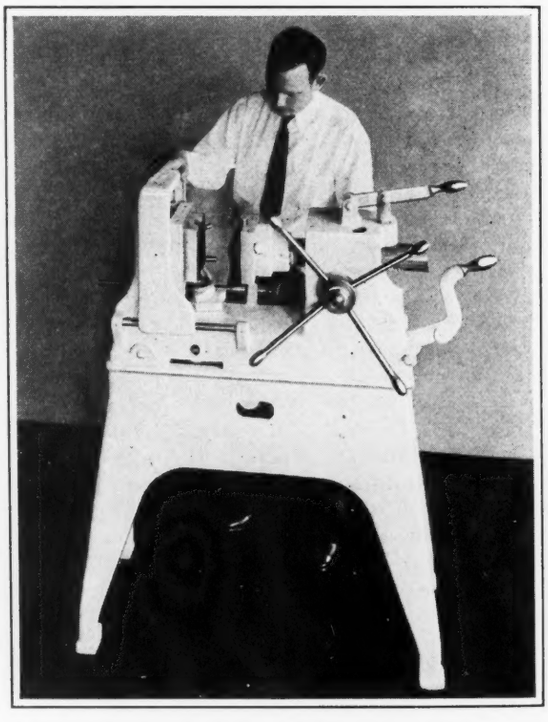
Madison-Kipp Small Die-Casting Machine

The Madison-Kipp Corporation, 203 Waubesa St., Madison, Wis., has produced a small die-casting machine known as the "Kipp-Caster No. 11—the Mechanical Foundry." The particular features of this machine are its size; ability to handle all common die-casting alloys, including magnesium; quick die-changing arrangement; and convertibility into a permanent mold machine for casting brass. No previous training in the art of die-casting is required for its operation.

The mechanism is built into a one-piece semi-steel casting a yard long, which is mounted on a one-piece leg casting. Other



Reed-Prentice Machine Designed for Milling Operations of the Interrupted-groove Type



Madison-Kipp Die-casting Machine Having a Body that is Only Three Feet Long

essential parts are the ram, main pinion (which is operated by the spoked wheel), metal well, metal-forcing plunger, plunger-operating lever, and die-locking plunger. The stationary half of the die is mounted on the head platen, while the movable half is mounted on the ram die-head and is carried to the stationary half when the spoked wheel is rotated to the left.

The main pinion wheel which operates the ram also moves an auxiliary rack to position the metal properly under the dies. When the dies are closed, the well is automatically raised into the casting position, and when they are opened, the well is automatically lowered into the pouring position. A lock prevents the dies from opening while metal is being forced into the die cavity.

The metal plunger is operated in the well by a heavy lever which is ordinarily latched. To apply pressure to the metal, this lever may be merely unlatched and allowed to fall or it may be pumped.

In operation, molten metal is poured into the well by means of a ladle. Then the dies are closed by the spoked wheel, after which the plunger lever is unlatched or pumped. When these steps have been performed, the plunger lever is raised, the die-locking plunger is raised, and the dies are opened by means of the spoked wheel. The castings are automatically ejected by knock-out pins fastened to a plate in the hub portion of the movable die. It requires about fifteen seconds to complete the cycle, the production, of course, depending upon the operator.

The dies used on this machine are known as Kipp "Cam-Lock" dies. They are made of cast iron, alloy iron, or die steel, depending upon the metal to be cast and the length of run. Core pulling is accomplished automatically with the opening and closing of the dies. A parting-line splash guard moves in unison with the movable half of the die, but in the opposite direction.

To convert the machine from a pressure die-casting machine into permanent mold equipment for the gravity casting of brass, a screw is adjusted, which causes the metal well to remain stationary in its lowered position. The metal plunger and the plunger handle remain inoperative, but the die is closed and opened in the same way as for pressure casting, and the core pulling and casting ejection are automatic.

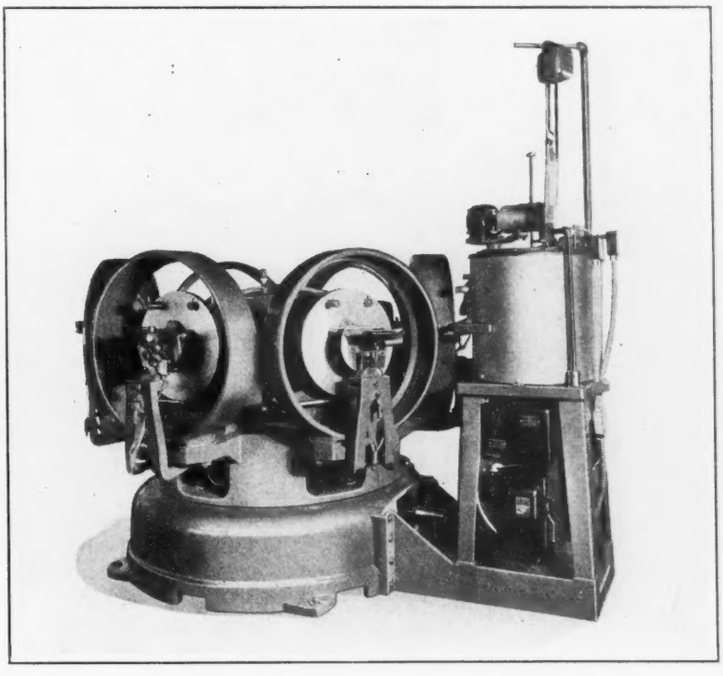
M. C. E. Automatic Centrifugal Babbitting Machine

A continuous automobile connecting-rod babbitting machine that is completely automatic, except for loading and unloading the work, was recently built by the Manufacturers' Consulting Engineers, Syracuse Bldg., Syracuse, N. Y. As each of the six babbitting heads comes to the operator, the fixture is opened so that the operator can remove the babbitted connecting-rod and replace it with a tinned unbabbitted rod. As the head leaves the operator, the fixture closes and clamps the new piece, and the spindle of the head starts to rotate.

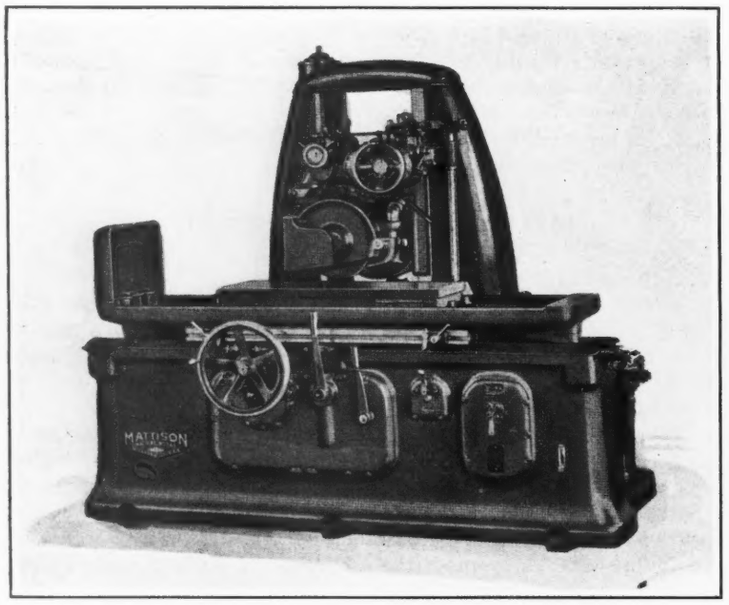
When the head passes the spout of a babbitt crucible, a measured quantity of babbitt is poured into the rod. The spindle, fixture, and rod continue to rotate until the babbitt has solidified. The spindle stops rotating as the fixture is indexed back to the loading and unloading position.

If for any reason the operator fails to load a fixture, babbitt will not be poured when the fixture passes the spout of the crucible. Also, if for any reason the operator does not want babbitt to be poured into a piece in any particular head, he can trip a mechanism that will prevent it from occurring.

The temperature of the electrically heated crucible is controlled by a thermostat. An automatic pig feeder maintains the level of babbitt in the crucible. The molten babbitt is agitated by a motor-driven device, the spindle of which is withdrawn



Automatic Centrifugal Babbitting Machine Designed for Handling Automobile Connecting-rods



Mattison Hydraulic Surface Grinder Built in 12- and 14-inch Table Widths

when the machine is to be shut down and the babbitt allowed to cool.

The machine is driven by a motor located under the babbitt crucible. All electric control switches are located in a convenient position for the operator.

Mattison Hydraulic Precision Surface Grinders

The hydraulic precision surface grinding machine built by the Mattison Machine Works, Rockford, Ill., has been brought out in two additional sizes, with 12- and 14-inch wide tables, for tool-room work, as well as production grinding. A 16-inch machine of this type was described in October, 1931, MACHINERY, page 141. As on the larger machine, the rotor of the motor that drives the wheel-spindle is mounted directly on the spindle and is balanced with that unit. The wheel-spindle, with the built-in motor, is mounted in a heavy housing that is carried on horizontal ways of the wheel-slide assembly. This assembly, in turn, is supported between two columns having taper gibbed ways.

The longitudinal table travel is operated by two hydraulic cylinders which provide a uniform speed in either direction. The stroke can be adjusted by table-reversing dogs. Table speeds from 30 to 90 feet per minute are available. The transverse feed of the wheel is also hydraulically obtained. The wheel advances across the work automatically at each reversal of the table. This automatic cross-feed makes it possible in the many grinding operations for one man to run two machines.

All operating and adjusting levers, handwheels, push-buttons, and switches are concentrated at the front of the machine. The illustration shows a hand hoist for raising the wheel from the work. With a power hoist, raising of the wheel is controlled by a push-button located in the end of the clutch lever. Thus, with one movement, the raising and lowering motor is started and the power clutch is engaged. The downward movement of the wheel is controlled by a separate push-button, so arranged that the travel continues only while the operator keeps the button depressed. This enables him to "spot" the wheel just above the work. A final adjustment for grinding is made by means of a handwheel and stop, provided with graduations of 0.0001 inch.

On these machines, the wheelhead can be adjusted vertically to give a maximum distance of 16 1/2 inches between the table surface and the 14-inch grinding wheel. The table working surface may be 3, 4, or 5 feet long. The 3-foot machine weighs 8750 pounds; the 4-foot, 9500 pounds; and the 5-foot, 10,500 pounds.

Automatic Force-Feed Lubrication for Monarch Lathes

Automatic force-feed lubrication has been adopted as standard equipment for the bed, carriage, apron, and compound rest of all lathes manufactured by the Monarch Machine Tool Co., Sidney, Ohio. With this equipment, the lathes have only fourteen places that need occasional oiling. Two of these places require oil once a year, five once a week, and seven twice a week. All major units are oiled by centralized systems and all parts of the oiling system are built in and concealed. The oil sump can be quickly cleaned of dirt or sediment.

The apron has a reservoir in the bottom which holds from 1 to 2 gallons of oil, depending upon the size of the machine. A pump, automatically driven by the apron handwheel, supplies oil under pressure to every part of the carriage that bears on the bed and to the compound-rest bottom-slide bearings of the carriage. The large-diameter apron gears dip in the oil and carry it to the entire gear train. A reservoir in the top of the apron is automatically filled with oil, which is supplied through tubes to all of the roller bearings in the apron. The headstock is oiled by the splash system, while the quick-change gear-box is oiled from central reservoirs. The centralized system saves time and insures oil being delivered to every bearing point.

Erie Variable-Stroke Board Drop-Hammer

In a board drop-hammer of new design being introduced on the market by the Erie Foundry Co., Erie, Pa., a short stroke or a long stroke can be used at will, without delay, as well as a light or heavy blow. With this control, drop-forgings that have a large cross-section at one end and are comparatively small at the opposite end can be readily produced, because the stroke and the blow can be varied as required before the metal has time to cool.

The hammer treadle is operated in the usual manner with one foot. The length of stroke is governed by a slight rocking of the foot on the treadle. The illustration shows this variable-stroke equipment applied to a Type M motor-driven hammer. It can be applied to hammers already in use.

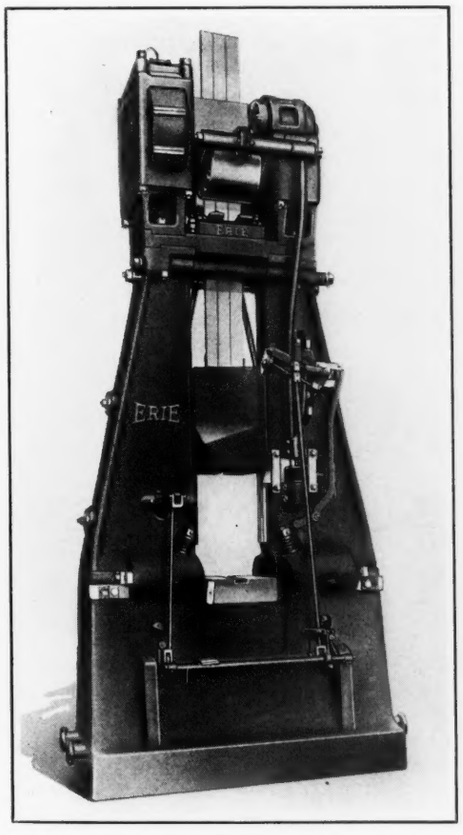
In tests made on one of these new hammers, it was shown that a considerable saving in power is obtained when striking short blows, but a factor of even greater importance, from the point of view of production, is the increased speed at which the hammer can be operated.

Toledo Improved Heavy-Duty Presses

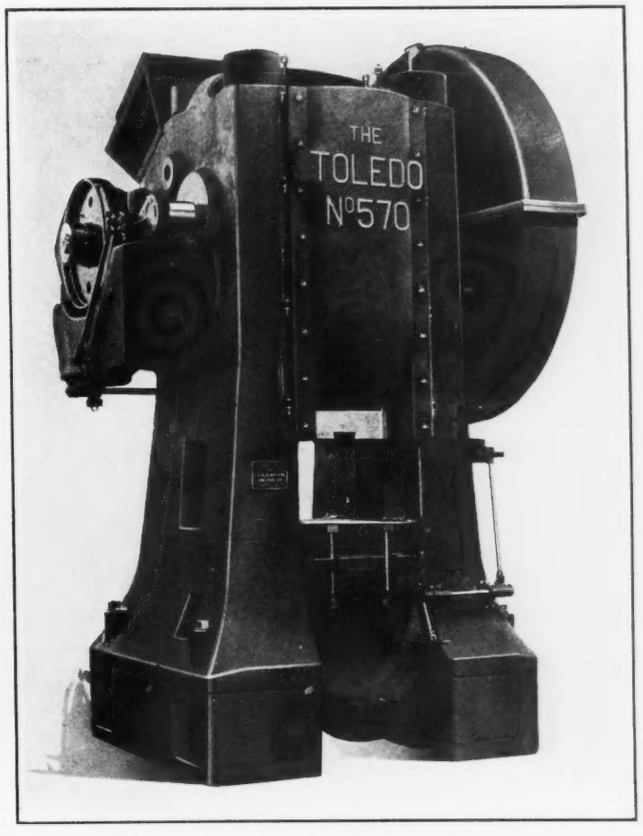
The line of heavy-duty presses introduced on the market last year by the Toledo Machine & Tool Co., Toledo, Ohio, which were described in April, 1931, MACHINERY, page 632, have been improved in many respects and patents have been applied for. The illustration shows one of the latest of these presses which was shipped to a motor car manufacturer for heavy squeezing, embossing, and sizing operations.

The frame is a single steel casting of heavy cross-section, reinforced by four extra large steel tie-rods, which are shrunk in place. The legs or supporting blocks are unusually substantial to carry the heavy weight. They are used only when a pit is not wanted. The crankshaft is of the full eccentric type and is of large diameter. It is heat-treated and normalized. There is no adjustment in the steel connection, thus providing solid metal between the crank and the slide. A wedge adjustment is provided under the bolster.

The slide is a long steel casting, guided in front by bronze-faced gibs. The gibs are bolted against the frame and tie the uprights of the press together in a manner that adds to the rigidity of the machine. The front gibs are continuous from the top to the bottom of the



Erie Board Drop-hammer with Instantly Variable Stroke and Blow



Toledo Press Designed for Heavy Squeezing, Embossing, and Sizing Operations

slide. Four tapered bronze gibs are set in the frame in back of the slide. These gibs permit adjustments to take up possible wear and to insure true alignment of the slide. Since the slide is guided at both the top and bottom, there is no possibility of its tilting. The press is arranged to receive a lower cam-actuated knock-out and also an upper knock-out.

Single gearing is used for the drive, so that the press can be operated at a high rate of speed, considering its size. Steel cut herringbone gears are employed, which are enclosed in a cast-iron guard that is supplied with lubricant.

The press is controlled by an improved multiple-disk friction clutch, together with an independent brake on the back-shaft. The operating mechanism is air-controlled and is actuated by means of the foot treadle. This mechanism is so arranged that the press may be operated continuously and stopped at will or one cycle can be made for each depression of the foot-treadle, stopping at the top center. A 30-horsepower motor mounted on top of the frame is connected to the flywheel by V-belts.

Junkin Triple Interlock Safety Guard

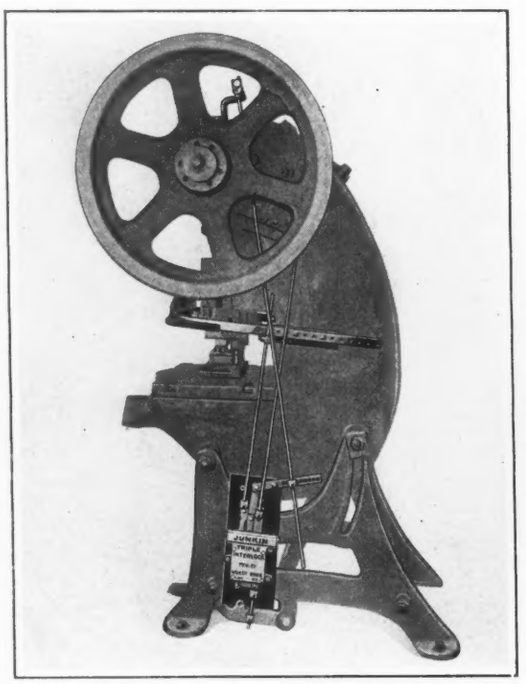
A guard for punch presses, shears, and other pedal-controlled machinery, designed to protect the operator from accidents and at the same time give him free use of both hands, has been placed on the market by Wuest Bros., 930-936 W. Hill St., Louisville, Ky. When the foot-pedal is depressed, the guard, which is light and cushioned so that it will not injure the operator's hand, is automatically unlocked and falls by gravity. If the operator should have his hand in the way and thus prevent the guard from dropping all the way down, the pedal would lock so that the press could not be tripped. Only when the guard is down the full amount can the press be tripped.

The operation of the guard occurs 180 degrees ahead of the ram. As the ram starts down, the guard starts up, the motion being slow at first. The guard is all the way up by the time that the ram passes the bottom center.

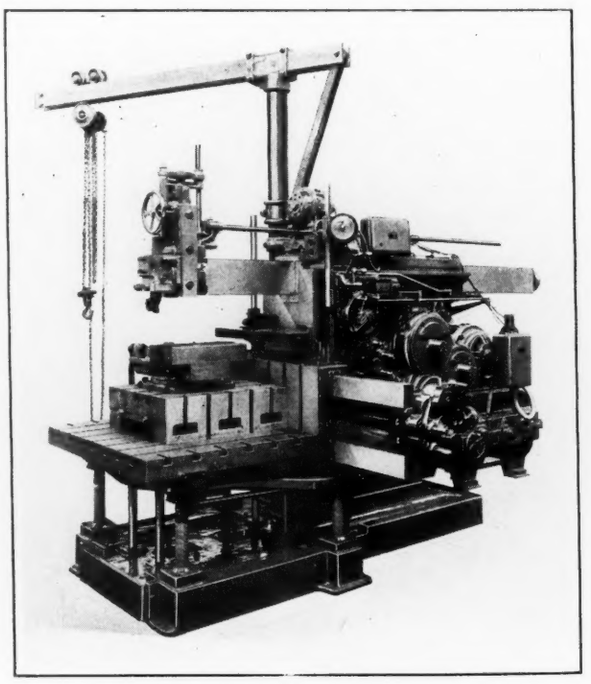
The guard does not interfere with the placing of work in the dies. It is claimed that operations are speeded up with this device, because the operator knows that the press is locked and cannot be tripped until the guard is all the way down and his hands are entirely out of the danger zone.

Morton Draw-Cut Shaper with Head Having Vertical Feed

A special head equipped with a motor-driven rapid traverse and vertical feed of 14 inches is one of the features of a high-duty draw-cut shaper recently brought out by the Morton Mfg. Co., Broadway and Hoyt St., Muskegon Heights, Mich., pri-



Punch Press Installation of Junkin Triple Interlock Safety Guard



Morton Draw-cut Shaper with Power Rapid Traverse and Vertical Feed

marily for use in railroad and industrial shops. This shaper has a stroke of 60 inches, a horizontal or side feed of 60 inches, and a vertical feed of 27 inches. The maximum distance between the ram and the sub-table is 38 inches. Another feature of the equipment is a special push-and-pull cut clapper-box which has a tool slot on each side.

This shaper is of the patented four-screw type, designed to facilitate the handling of heavy bulky castings. There is a rapid power traverse horizontally as well as vertically, and the automatic feeds can be changed while the machine is in motion. Fifteen horsepower is required for driving purposes, the power being delivered through a variable-speed transmission which gives thirty or more cutting speeds.

This shaper will accommodate various attachments intended for use in railroad shops, such as shell-planing, shoe-and-wedge, locomotive cross-head, and rod-brass attachments.

"Position Finders" and Handling Apparatus for Welders

The Harnischfeger Corporation, 4400 W. National Ave., Milwaukee, Wis., has developed two types of equipment known as "Position Finders," which are intended to facilitate operations in welding shops. The Type T equipment is shown in use in a shop provided with an overhead crane and hoist designed to readily place work on the Position Finder and remove it at the end of an operation. This material-handling equipment was supplied by the same concern.

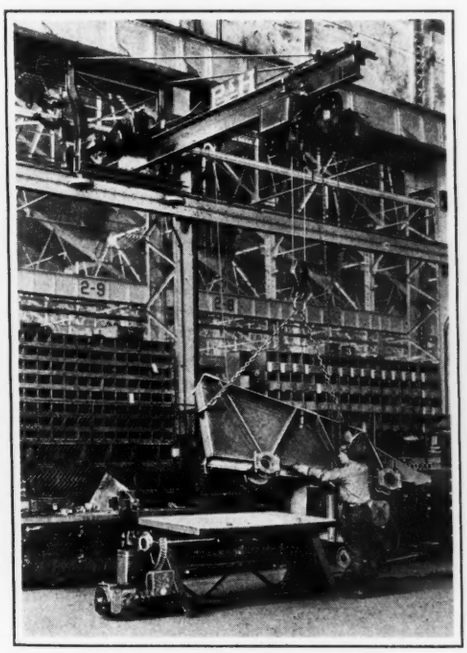
When the work has been tacked down to the renewable top supports of the Type T Position Finder, it can be tilted into any desired welding position within an arc of 60 degrees in either direction. This permits of so positioning the work that welding metal can be deposited in a horizontal trough. This Position Finder is especially intended for one- and two-side work of irregular dimensions.

The Type L Position Finder is intended especially for long, narrow structures that must be welded on four sides. This equipment consists primarily of two headstocks arranged on a structural base. The headstocks are adjustable to accommodate structures from 1 to 16 feet in length, and work mounted on the spindles of the headstocks can be rotated 360 degrees around the horizontal axis.

Elwell-Parker Die-Handling Truck

Dies up to 10,000 pounds in weight can be handled by a tiering truck recently designed by the Elwell-Parker Electric Co., Cleveland, Ohio, especially for this class of service. This truck has a lift of from 11 to 106 inches. Its height is 88 inches.

In using this equipment for removing a die from a press, the truck is brought to the machine, head on. Then the cantilever platform is elevated to the level of the press bed, after which the hooks of two cables at the sides of the uprights are led under the



Harnischfeger Equipment Built to Facilitate Welding Operations

Elwell-Parker Electric Tiering Truck Designed Especially for Handling Dies

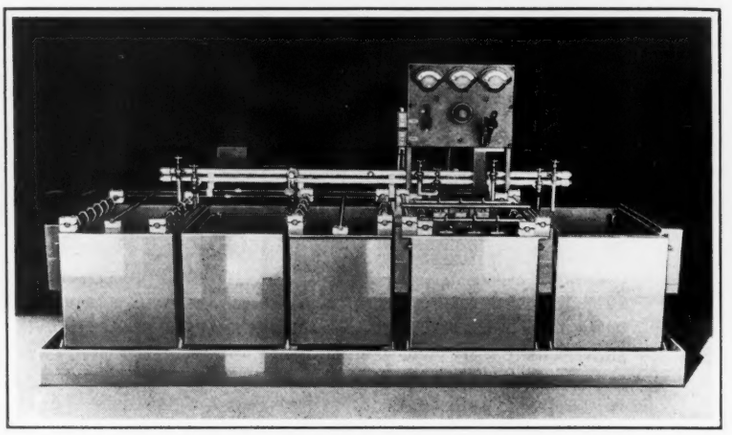
sheaves at the lower end of the uprights and attached to the die.

A winch on the truck is then used to wind in the cables and draw the die on the platform of the truck. After the platform has again been lowered, the die can be readily conveyed to the storage room or to some other machine, as required.

Cutler-Hammer Water-Tight Push-Button Stations

A line of push-button master stations operated from levers on the side of the case instead of from push-buttons on the front has been placed on the market by Cutler-Hammer, Inc., 264 N. 12th St., Milwaukee, Wis. The shafts of the levers operate through stuffing-boxes and the cover joint is sealed by means of a rubber gasket. The advantage claimed for this construction is a truly water-tight station, suitable for use under severe atmospheric conditions.

The stations use standard heavy-duty push-button elements, which are mounted on removable molded bases and are fully enclosed. The stations are supplied in all normal ratings, and are one-button (on and off), two-button (start and stop) and three-button (hoist, lower, and stop) styles.



Chromium-plating Outfit Designed Especially for Installation in the Tool-room

Chromium-Plating Unit for Machine Shops

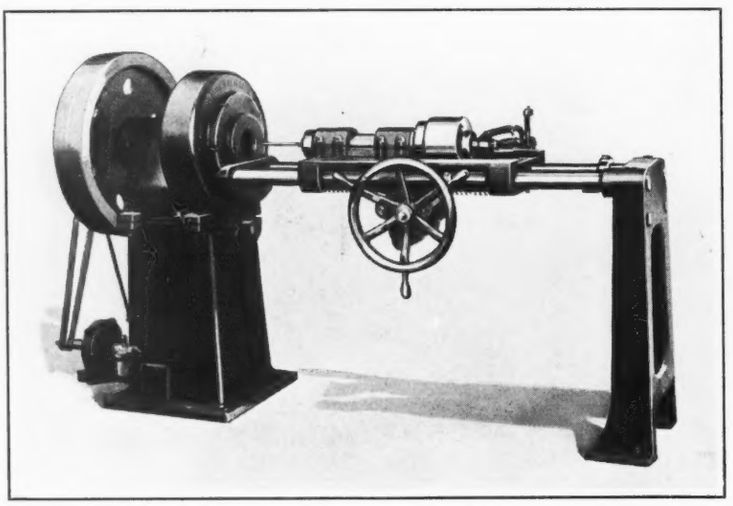
Drills, taps, reamers, files, dies, punches, and many other tools and parts that may be chromium-plated in order to lengthen their life can now be plated as a part of the regular routine of the tool-room by using a compact unit that is being introduced on the market by United Chromium, Inc., 51 E. 42nd St., New York City. This plating unit may be moved right into the tool-room and immediately connected to current, steam, water, and waste outlets. It can be operated successfully by almost any workman in the shop. The entire outfit is assembled on one base.

Langelier Swaging Machine for Reducing Valve Blanks

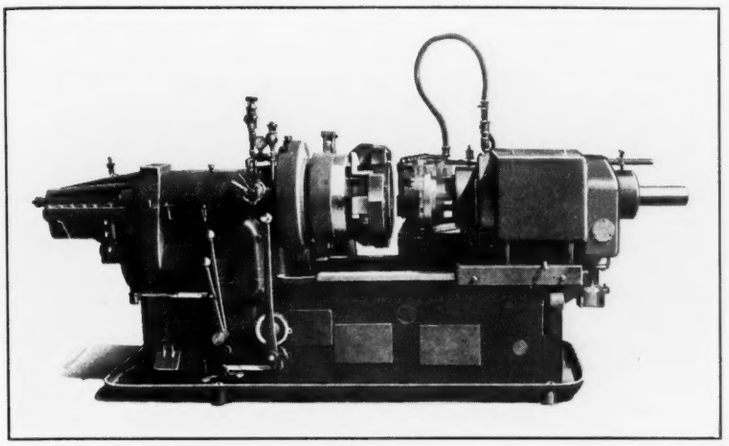
A swaging machine constructed with four dies for reducing automobile tappet-valve blanks before upsetting them has recently been designed by the Langelier Mfg. Co., Providence, R. I. This machine has a water-jacketed head and is equipped with Timken roller bearings. The stock is fed to the swaging dies by a rack and pinion, operated by a handwheel. Compound gears interposed between the handwheel and pinion shafts insure sufficient power and easy feeding.

An automatic air chuck grips the work on the forward movement of the saddle and releases it automatically at the end of the feed stroke. The tendency for hot stock to become twisted during the swaging is offset by the chuck being allowed to rotate. A certain amount of friction is applied to control the speed of rotation of the chuck.

Interchangeable collets permit swaging any size of blank up to the capacity of the machine. The operation on the valve blanks consists of reducing them from



Langelier Swaging Machine with Water-jacketed Roller-bearing Head



Gisholt Simplimatic Modified for Rough-machining a Combined Automotive Brake-drum and Front Wheel Hub

21/32 inch diameter to 25/64 inch diameter in a single hot-swaging operation. Any length of work up to 20 inches can be handled by the feed mechanism.

This equipment occupies a floor space of 30 by 90 inches, has an over-all height of 50 inches, and weighs approximately 1800 pounds.

Gisholt Brake-Drum Machine

A modified "Simplimatic" has recently been built by the Gisholt Machine Co., Madison, Wis., for rough-machining a front wheel hub and brake-drum combined in a single malleable iron casting. Replacing the traversing platen table of the standard Simplimatic is a fixed tailstock housing. This housing carries a boring spindle, actuated horizontally by a large cylindrical cam. The housing also includes gearing which completes the feed mechanism.

In place of the customary air-operated chucking equipment, there is a wrenchless chuck operated by an air cylinder at the rear of the machine. With this arrangement, the bore of the work-spindle is left clear for the addition of a back boring attachment.

When the machine is started, all tools are traversed rapidly to their starting positions. The boring head carries twelve tools for rough-boring the 14-inch diameter by 3 3/16-inch wide braking surface; and six tools for machining a seat in the hub to receive the inside tapered roller bearing. The back boring attachment carries a six-cutter head for boring the seat for the outside tapered roller bearing.

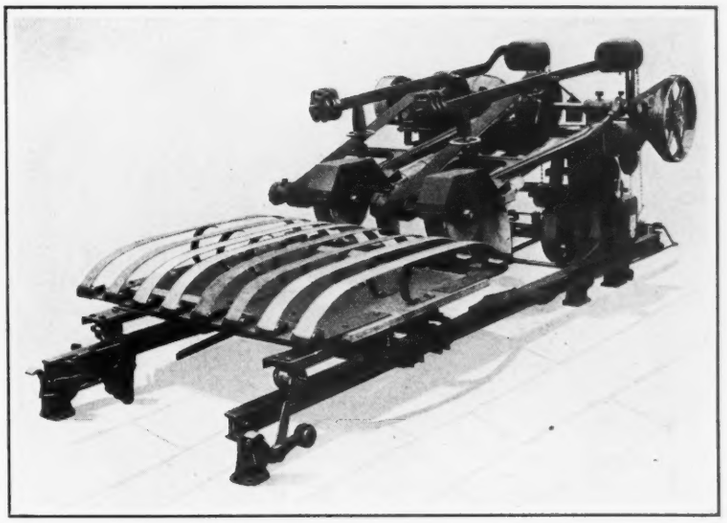
A rear slide mounted at an angle of 45 degrees with the axis of the work carries tools for chamfering the bore of the brake-drum, for facing the end of the drum, and for turning the flange along the outside diameter. There are twenty-seven cutting tools and blades and they are fed in four different directions to perform the operation.

Through the use of cemented carbide tools, which permit high cutting speeds, and multiple-cutter boring heads, which permit heavy feeds, the machine is capable of turning out these drums in 1 1/4 minutes each, floor-to-floor time.

The second operation on the drums—facing the wheel seat and finish-boring the bearing seats—and the third operation—single-point finish-boring the braking surface concentric with the tapered roller bearing cups—are performed in 1 1/4 and 2 1/2 minutes, respectively. Both of these operations are performed in Simplimatics of a more standard construction than the one described.

Excelsior Automatic Bumper-Polishing Machine

The Excelsior Tool & Machine Co., 30th to 32nd St., Ridge to Jefferson Ave., East St. Louis, Ill., has developed an automatic polishing machine that will polish high-curved, straight, and edge-bent automobile bumpers. A uniform finish is obtained



Continuous Bumper-polishing Machine Built by the Excelsior Tool & Machine Co.

without reversing the bumpers in the machine. Two bumpers are polished at one time.

The pressure applied to the polishing wheels is equalized by a patented mechanism which guards against severe wear on the wheels as they pass up the curved surface of a bumper. The bumpers are fed under the wheels, which travel in the opposite direction to the bumpers. A lateral resiliency in the carriage allows the polishing wheels to follow the bumpers if they are curved edgewise slightly.

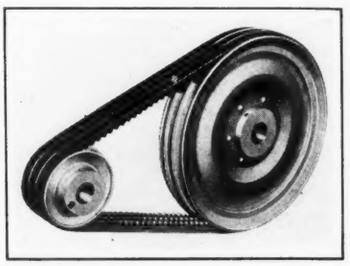
The lower carriage is adjustable to suit any length of work, and can be stopped at both the front and back positions. The upper carriage, which is equipped with quick-releasing fixtures for eight bumpers, is shifted sidewise a distance of one bumper at the end of the forward or back stroke. This is accomplished by turning a handwheel and locking device. The bumpers pass under the polishing wheels from two to eight times, depending upon the finish required, before the upper carriage is shifted.

The machine is never stopped for removing finished bumpers, as this can be done while an operation is in progress on adjacent bumpers. A special attachment can be supplied for polishing edge-bent bars. This machine has a weight of approximately 5600 pounds.

Day-Steel V-Groove Pulleys

The Dayton Rubber Mfg. Co., Dayton, Ohio, has brought out a new line of Day-Steel single and multiple V-groove pulleys for use with Dayton Cog-Belts. These pulleys are intended for ratings up to 7 1/2 horsepower. They are formed from heavy-gage pressed steel and are welded both at the rim and the web.

The pressed-steel part is assembled on a hub made to insure a true running pulley. The construction gives a lightness that makes the pulleys particularly suitable for transmitting the lower horsepowers. An aluminum finish gives the pulleys an attractive appearance.



Pressed-steel Pulleys for Use with Dayton Cog-Belts

Kingsbury Power-Indexed Drilling and Reaming Machine

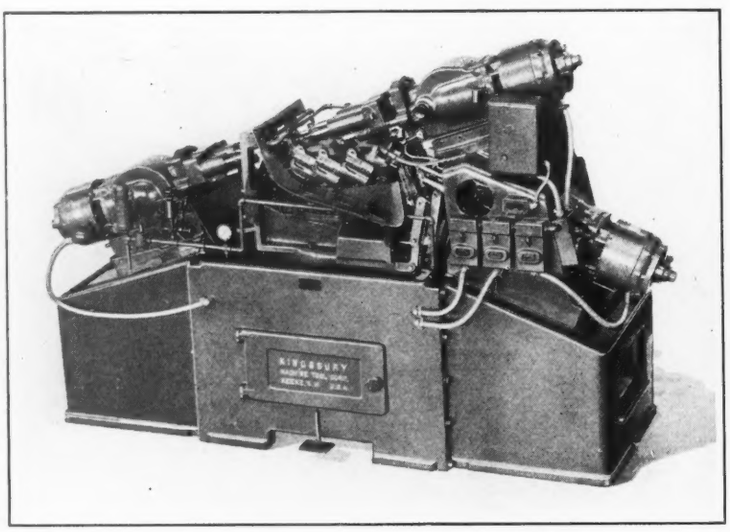
A Type TA power-indexed drilling and reaming machine recently developed by the Kingsbury Machine Tool Corporation, Keene, N. H., for drilling and reaming the pin-holes in hinges is shown in the accompanying illustration. One of the features of this machine is that, by tilting the work in its nest, pieces can be drilled from opposite sides without requiring a trunnion type of indexing fixture. The work is drilled from opposite sides at Station No. 1 by the left-hand and upper right-hand heads. It is line-reamed at Station No. 3 by the lower right-hand head. An intermediate operation can be performed at Station No. 2, if desired.

The cabinet base of the machine contains the power indexing unit, coolant reservoir, and pumping unit, all of which are accessible through the door. Chip clean-outs are provided at both ends of the base. In the center, the base supports the horizontal indexing dial, and on the inclined surfaces, the drilling and reaming units.

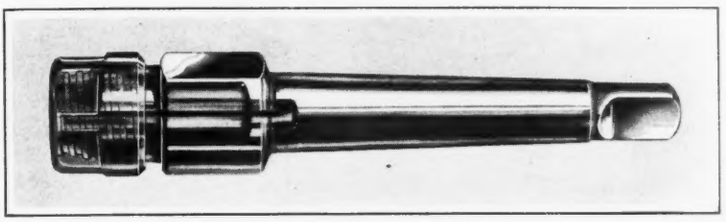
Three-spindle auxiliary heads are mounted on each drilling or reaming unit and three work-holding nests are provided at each station of the dial. With this arrangement, three pieces are completed upon each indexing of the machine. The hinges may be of one size or of three different sizes.

The indexing of the dial is controlled by means of a foot-treadle, thus leaving the operator's hands free for loading. After placing the work in its nest, the operator depresses the treadle. This starts the power-indexing mechanism, and the three newly loaded fixtures are indexed to Station No. 1. During the drilling of these pieces the operator loads the next set of fixtures. The subsequent operations are, of course, performed simultaneously at the succeeding stations.

A pin automatically locks the



Kingsbury Hinge Drilling and Reaming Machine with Power Indexing Feature



Jacobs Chuck Designed for Holding Tools of a Single Size Only

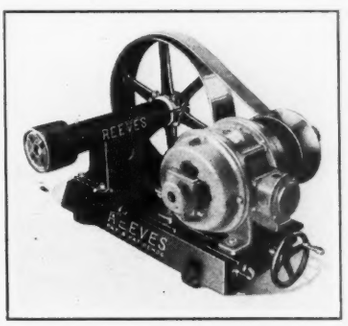
dial in its indexed positions, and individually air-operated toggle clamps keep the work rigid for the different steps. While being indexed from the reaming station to the loading station, the work is automatically ejected.

Various adjustments permit the machine to be adapted to other classes of work. When the power indexing feature is not required, a hand indexed fixture can be furnished. All drill spindles can be adjusted longitudinally to permit using drills of various lengths in the same auxiliary heads.

Reeves Variable-Speed Motor-Pulley Countershaft Unit

For installations requiring an unusually large speed reduction, the Reeves Pulley Co., Columbus, Ind., has brought out the variable-speed motor-pulley countershaft unit here illustrated. This unit comprises an adaptation of the "Vari-Speed" motor pulley made by the concern, which consists of two opposing cone-faced disks—one stationary and one sliding—and an adjustable power compression spring. All of these are mounted on the shaft of a standard electric motor, and the entire assembly is attached to a special motor base.

A V-belt forms the connection between the sliding disks and the driven pulley. By turning the handwheel in one direction, the motor and disk assembly is moved away from the driven pulley; as this occurs, the sliding disk moves outward laterally so that the V-belt travels over a smaller diameter between the disks, thus effecting a greater speed reduction. When the handwheel is operated in the opposite direction, the motor is moved toward the driven shaft, and the V-belt then operates on a larger diameter of the disks, thereby increasing the speed of the driven machine.



Reeves Variable-speed Unit for Unusually Large Reductions

Any standard type of drive can be applied to transmit the power to the driven machine. The countershaft is of ball-bearing construction and is adjustable on the base. This feature permits of selecting a pulley size that, in conjunction with the "Vari-Speed" motor pulley, will provide the desired speed variation. This countershaft unit is built in seven sizes, ranging from fractional to 7 1/2 horsepower capacity.

Jacobs Single-Purpose Chuck

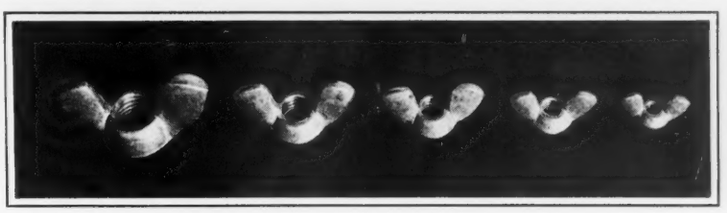
A chuck designed particularly for multiple-spindle drilling, tapping, and reaming operations where close center distances require a chuck of minimum diameter is one of the latest additions to the line of the Jacobs Mfg. Co., Hartford, Conn. This chuck can also be used advantageously on other machines for holding tools of a single size. It is of a self-centering design.

Unusual gripping power, together with a rapid and positive release, is obtainable through the use of a tapered thread on the split holder and on the nut. The nut can be easily tightened or loosened by means of a monkey-wrench, with the chuck on or off the machine. No change takes place in the end adjustment of the tool during the tightening operation.

Morse taper shanks are supplied as standard, but straight shanks or shanks with special tapers can be furnished, as well as those of threaded construction, if desired. The chucks are made in seven standard models, the tapered hole ranging from Morse No. 1 to No. 3.

Parker-Kalon Cold-Forged Wing-Nuts

Drop-forged wing-nuts of steel and brass, made in five blank sizes by a high-speed automatic process, are being placed on the market by the Parker-Kalon Corporation, 200 Varick St., New York City. In the U. S. standard machine screw sizes, these wing-nuts are carried in stock from No. 6 to 1/2 inch. The wings are uniform and are



Parker-Kalon Wing-nuts, Cold-forged from Steel and Brass

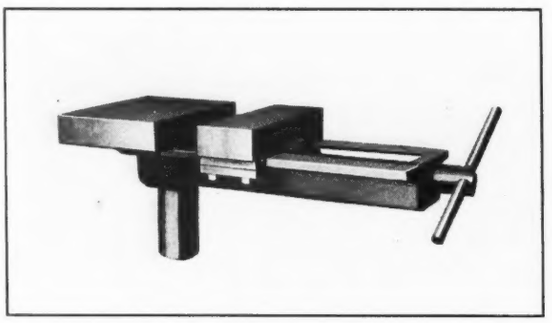
shaped to provide ample finger grip for drawing them up tight and to facilitate their removal. The over-all length across the smallest nut is 13/16 inch, and across the largest, 1 7/8 inches.

The steel wing-nuts are stocked in the plain steel finish only, but they can be furnished cadmium-plated, nickel-plated, brass-plated, copper-plated, chromium-plated, Parkerized, oxidized, and electro-galvanized. The brass nuts can likewise be supplied in most of these finishes.

Link-Belt Motorized Speed Reducer

A motorized speed reducer of the design illustrated has recently been added to the line manufactured by the Philadelphia Plant of the Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. By providing the motor with an extended shaft and mounting it on the reducer as shown, less floor space is required and a high-speed motor-shaft coupling is eliminated. Roller bearings and continuous-tooth herringbone gears are used in the construction.

The reducer illustrated is a triple reduction unit with a speed ratio of about 312 to 1. The motor shaft operates at 1165 revolutions per minute and the low-speed shaft at only 3.75 revolutions per minute.



Combination Drill Table and Vise of Welded Construction

Square-Type Combination Drill Table and Vise

A combination drill table and vise which performs the same functions as the larger models made by the Modern Machine Tool Co., Jackson, Mich. (previously described in the technical press), is being placed on the market by the same concern, primarily for use in the smaller shops. This model is constructed of plates and angles welded together and machined. It is available in three sizes with 6-, 7-, and 8-inch square tables, which open from 4 to 4 1/2 inches. All vises are 1 inch deep.

Lincoln Head Shield for Welders

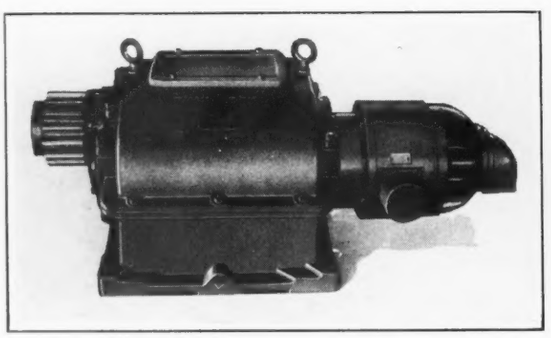
A welding operator's head shield, intended to augment production by increasing the efficiency of the operator, has been designed by the Lincoln Electric Co., Cleveland, Ohio. This head shield, which is known as the "Weld-Fast," has a movable protective lens that enables the operator to obtain a clear view without raising the shield. Thus both hands are free, so that welding operations can progress with few interruptions.

The protective lens is held in place in a vertical slide by means of a spring. A slight pressure exerted with the chin on the aluminum rest shown in the right-hand view of the illustration is sufficient to raise the lens when the operator wants to look at the work or change electrodes. When the pressure is removed, the lens automatically falls back into place. A stationary cover glass guards the lens against spatter and protects the operator from flying sparks in case the movable lens is accidentally raised.

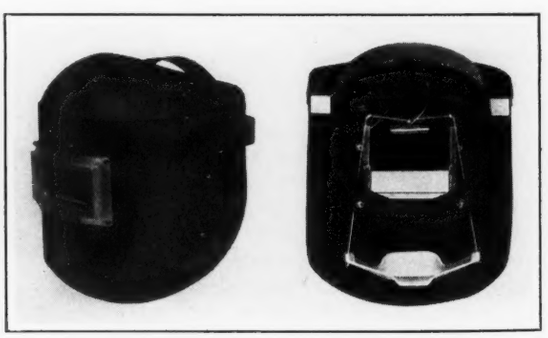
In order to keep the weight of the shield at a minimum, aluminum is used for the case that encloses the glasses, and a feather-weight fiber is used for all other parts. There is sufficient room in the shield to allow the operator to wear eye-glasses.

Improved Wyromatick Compensator

The Wyromatick compensator—a device for automatically maintaining a constant adjustment of bearings—is now manufactured by the Federal-Mogul Corporation, Detroit, Mich. The



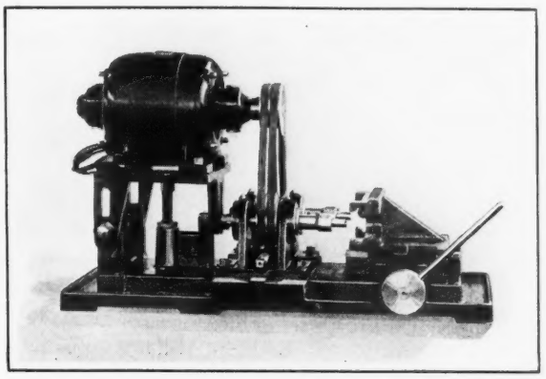
Link-Belt Speed Reducer Driven by Motor Shaft that Extends into the Reducer Unit



Lincoln Head Shield for Welding Operators, with Lens that can be Raised by the Chin

present model embodies a number of improvements over the one described in the technical press a year or two ago at the time that the compensator was being introduced on the market by the Wyrick Engineering Co., Wyandotte, Mich.

The most advantageous improvement is a pre-load feature, which insures that any clearance necessary to allow for expansion and contraction will not be in the bearing itself, but will be positively controlled within the compensator.

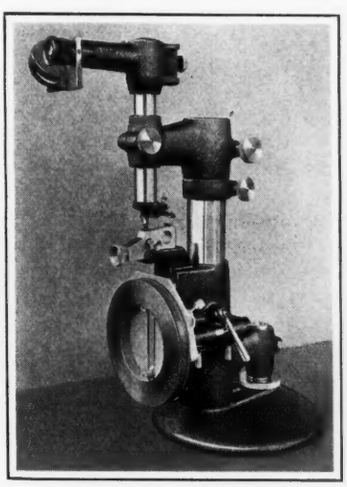


Langelier Bench Type Machine with Adjustable Horizontal Spindles

Langelier Bushing Finishing Machine

A two-spindle horizontal bench type machine was recently built by the Langelier Mfg. Co., Providence, R. I., for finishing the lead bushing inserts in the molded rubber covers of Ford batteries. The spindles of this machine are mounted in ball bearings and are motor-driven through two V-belts and grooved sheaves. Their center-to-center distance is adjustable from 3 1/4 to 6 inches.

Each spindle is equipped with a round cutter for removing a slug from the bottom of the bushing and a tool for finishing the diameter and top of the bushing, as well as the boss on top of the battery cover. The feed saddle which carries the work-fixture is operated by a hand-lever through a rack and pinion. This machine weighs about 175 pounds.



Vertical Optimeter with Internal Measuring Attachment

Internal Attachment for Vertical Optimeter

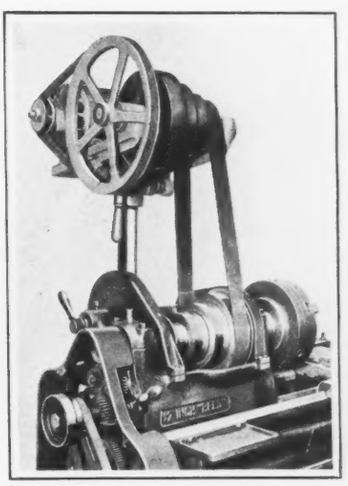
Inside measurements from 1/4 to 4 inches can be made in increments of 0.00005 inch with an adjustable attachment that has been made available for the Zeiss vertical Optimeter. Means are also provided for determining the taper of holes and for finding both the minimum and maximum diameters. The vertical Optimeter, which is an optical precision amplifying gage, was previously described in MACHINERY. Heretofore, this device has been limited to outside measurements.

The internal measuring attachment can be slipped over the vertical post of any standard Optimeter and clamped in position at the rear. There are two measuring jaws provided with ball tips. The upper jaw is adjustable, but is fixed in position during the measuring operation. The ring is suspended on this jaw by its own weight. The lower jaw effects the measuring motion and transfers it to the measuring anvil of the Optimeter tube by which the amplification is performed optically. The amplification is such that 0.0001 inch appears as large as 1/16 inch in the ocular or as large as 1/8 inch projected on the screen. This attachment, as well as the Optimeter, is sold by the George Scherr Co., 128 Lafayette St., New York City. The instrument is set with a master ring or a snap gage built up with gage-blocks.

Motor Drive Attachment

Various types of machine tools, including lathes, screw machines, shapers, milling machines, and drilling machines, may be equipped with a motor drive designed by John T. Peterson, production manager of the Master Sprayer Mfg. Co., 1814 Ogden Ave., Chicago, Ill. This drive, which is shown in the accompanying illustration installed on a 12-inch lathe, is being placed on the market by the concern mentioned.

For a 12-inch lathe, a 1/2-horsepower motor is supplied when heavy-duty work is to be performed, while a one-horsepower motor is provided for a 16-inch lathe. The advantage claimed for this drive is a saving in power and belting.



Motor Drive Attachment Made by the Master Sprayer Mfg. Co.

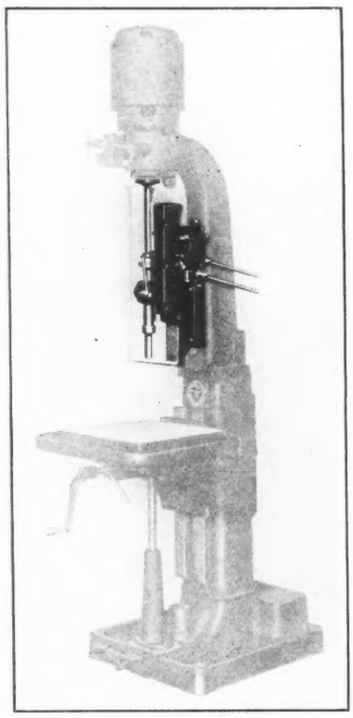
Hydraulic Feed for Leland-Gifford Sensitive Drilling Machines

The sensitive drilling machines built by the Leland-Gifford Co., Worcester, Mass., may now be equipped with the same hydraulic feed that has been furnished for a number of years on the Unit-Cycle machine manufactured by the concern. This feed is applicable to both belt and motor spindle types, and can be applied to new machines or to equipment already in use.

Either a continuous or a step-by-step control can be supplied for the hydraulic feed. When the operation is such that the drill does not have to be relieved in the hole because of the need for coolant or to furnish clearance for chips, the continuous feed cycle is furnished, while for drilling long deep holes in drop-forgings and other tough materials, the step-by-step method of control is provided. The latter method insures the removal of chips from the hole at regular intervals, and at the same time, allows a flood of lubricant to enter the bottom of the hole. Long drill life between grinds, less drill breakage, straight holes, and high production are advantages claimed for this method in such operations as drilling long oil-holes in crankshafts, connecting-rods, and king bolts.

Usually the maximum feed is 6 1/2 inches, although when long holes are to be drilled, a feed of 10 inches can be furnished. The length of the steps with the step-by-step control can be varied from 3/16 inch up. The rate of feed is adjustable from 0 to 40 inches per minute. A rapid approach and return are provided for, and the entire feed mechanism stops automatically at the end of each cycle. A hand starting arrangement can be provided for individual hydraulic feed units or a number of units can be started simultaneously from one control valve.

The spindle and quill are quickly adjustable in the slide to position the drill in relation to the work and to suit drills of various lengths.

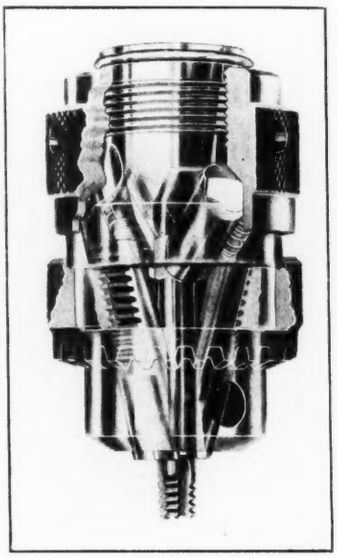


Hydraulic Feed Unit Applied to Leland-Gifford Sensitive Drilling Machine

Jacobs Positive-Drive Tap Chuck

A chuck designed especially for holding and driving taps is being placed on the market by the Jacobs Mfg. Co., Hartford, Conn. From the phantom view in the illustration, it will be seen that this chuck is equipped with two front jaws that hold the tap rigidly by the round shank, and two back jaws that drive the tap positively by means of the square end. The floating construction of the chuck compensates for any error in concentricity that may exist between the round portion of the shank and its square end.

While this chuck has been designed for use in heavy tapping operations, the balanced construction, light weight, and small diameter make it equally adaptable for use on high-speed sensitive tapping attachments. For light tapping, the chuck can be operated by hand, the Jacobs toothed sleeve and key being furnished for heavy-duty work. The key handle of the chuck wrench fits the spanner holes in the back sleeve. This feature is advantageous when the chuck is used in multiple-spindle operations.

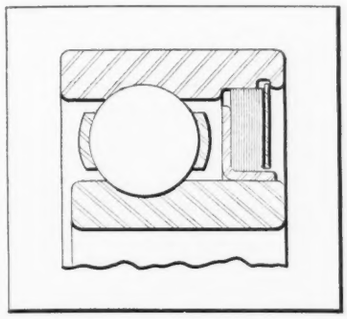


Jacobs Chuck which Drives Taps by the Square End

Three models of this chuck cover a hand-tap capacity ranging from 0 to 1/2 inch. The chucks are ordinarily made with the same tapered holes as standard Jacobs drill chucks, but special tapers and threads can be provided. All parts are hardened and ground.

Fafnir Improved Felt-Seal Bearing

An improved type of felt-seal ball bearing known as the T type has recently been developed by the Fafnir Bearing Co., New Britain, Conn. In this bearing, as will be seen from the illustration, the felt seal is placed inside the outer ring and is located by that ring. This construction does away with the pressed-steel shell that was fitted over one face of the J-type bearing described in June, 1930, MACHINERY, page 819. A more standard closure and a more effective sealing device are the advantages claimed for the new design.



Construction of the Fafnir Improved Felt-seal Bearing

By extending the width of both the inner and outer ring on one side of the ball race, space is provided for the entire seal assembly between the two rings. A steel slinger is first pressed on the inner ring. Then a woven felt washer is placed next to it and held in position by a spring-retaining washer that is fitted into a slight groove on the inside of the outer ring. An oilproof paper washer is slipped between the felt and the retaining washer in order to seal the opening in the latter.

The steel slinger rotates with the inner ring, while the felt washer revolves with the outer ring, thus providing a baffling effect. This T-type seal bearing is manufactured in the extra small 30 series, the light 200 series, and the medium 300 series.

Welding Torch Equipped with "Money Saver" Cutting Assembly

Cutting Attachment for Welding Torch

A cutting attachment intended for application to oxy-acetylene welding torches has been placed on the market by the Smith Welding Equipment Corporation, 2619-33 Fourth St., S.E., Minneapolis, Minn., under the trade name of "Money Saver." One of the advantages claimed for this attachment is that simple valves have been substituted for the levers ordinarily provided for making adjustments. The oxygen valve can be quickly opened and closed with the thumb.

Influence of Metal Coatings on the Fatigue of Steel

The effect on the resistance of metals to fatigue of coating them with some other metal depends on the nature of the bond between the metal and the coating, according to Research Paper No. 454, published by the Bureau of Standards.

It has been shown by numerous investigations that the surface condition of a metal is a very important factor in determining its resistance to repeated stresses. Surface alterations caused by corrosion, either previous to or coincident with stressing, are known to cause a marked lowering of the normal endurance limit of a metal. Metallic coatings are widely used to protect iron and steel from corrosion, and it has been shown that such coatings may improve the resistance of metals to simultaneous stress and corrosion.

It is also of interest to note what effect protective metallic coatings may have upon the endurance limit of metals when corrosion is not involved. A study has recently been made at the Bureau of Standards of the effect of hot-dipped galvanized coatings and of electro-deposited zinc coatings on the endurance limits of ferrous materials.

Endurance limits were determined for specimens of materials that were: (a) Polished but uncoated; (b) galvanized by the hot-dip process; (c) zinc-electroplated, and (d) acid-pickled as for galvanizing. Ingot iron was tested in the hot-rolled condition. Carbon steels were tested in the normalized and annealed, in the quenched, and in the tempered conditions. Fatigue tests of the galvanized and the uncoated specimens were made.

The acid-pickling caused a decrease in endurance of as much as 40 per cent, the greatest decrease occurring in the quenched steels. The presence of a galvanized coating caused a still greater decrease in most of the materials, the maximum, 42.5 per cent, being obtained in the quenched and the tempered steels. The endurance limits of the electroplated materials were equal to or greater than those of the polished uncoated materials.

The difference in the effects caused by the two types of coating is believed to be a result of the differences in the nature of the bond between zinc and steel, and differences in the structure and hardness of the two coatings.

* * *

Diesel Engine Manufacturers Elect New Officers

The Diesel Engine Manufacturers' Association has elected H. Birchard Taylor, consulting engineer of Philadelphia, Pa., president to succeed George W. Codrington of the Winton Engine Co., Cleveland, Ohio, who has been elected chairman of the board. E. T. Fishwick of the Worthington Pump & Machinery Corporation continues as chairman of the Executive Committee. The Diesel Engine Manufacturers' Association was organized in 1928, and has since been active in promoting trade standards in the Diesel industry and in gathering Diesel engine statistics.

MEN IN THE INDUSTRY

L. A. GRAHAM has been appointed sales manager, and M. A. CARPENTER, sales promotion manager of the Falk Corporation, Milwaukee, Wis., for all commercial products of this company. Foundry sales remain under the direction of A. Simonson, vice-president. The Falk Corporation manufactures gears, speed reducers, couplings, and other power transmission specialties, as well as steel castings. Mr. Graham has a wide experience in the selling and promotion of technical products. Mr. Carpenter has been in charge of all advertising activities of the Falk Corporation for a number of years, and now assumes charge of the newly organized sales promotion department.

WIRT S. SCOTT, special representative of the Westinghouse Electric & Mfg. Co., Mansfield, Ohio, was recently awarded the professional degree of electrical engineering by Ohio State University, in recognition of the work by which he has distinguished himself in the engineering field. Mr. Scott is recognized as an authority in connection with the economic application of electrical heating for industrial and commercial processes.

F. J. WINTERER has been appointed superintendent of production of the recently acquired Box Crane & Hoist line of the Shaw-Box Crane & Hoist Co., Muskegon, Mich., a subsidiary of Manning, Maxwell & Moore, Inc., New York. G. A. MITCHELL will be proposal engineer, and C. H. SCHRAMM designing engineer.

LOUIS ILLMER, who has had charge of the Brewer-Titchener Corporation's patent department for the last ten years, has entered private practice as a patent attorney and research engineer, at 111 Port Watson St., Cortland, N. Y.

E. M. UNDERWOOD, for the last fourteen years connected with Fairbanks, Morse & Co., Chicago, Ill., as sales engineer, has joined the combustion engineering department of the Patterson Foundry & Machine Co., and will be located at East Liverpool, Ohio.

ROBERT K. PLUMMER, formerly assistant sales manager of Gears & Forgings, Inc., Cleveland, Ohio, has joined the sales staff of the Perkins Machine & Gear Co., Springfield, Mass. Mr. Plummer will represent the company in the Cleveland and Chicago territories.

NORMAN W. FOY has been appointed Chicago district sales manager of the Republic Steel Corporation, Youngstown, Ohio. He will continue to make his headquarters at the district sales offices of the company in the McCormick Bldg., Chicago.

E. C. BRANDT has been appointed manager of renewal parts in all plants of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Mr. Brandt was previously assistant works manager.

RAY A. MILLHOLLAND, 5157 Winthrop Ave., Indianapolis, Ind., has resigned as vice-president and director of the Millholland Corporation. He has not yet announced his plans for the future.

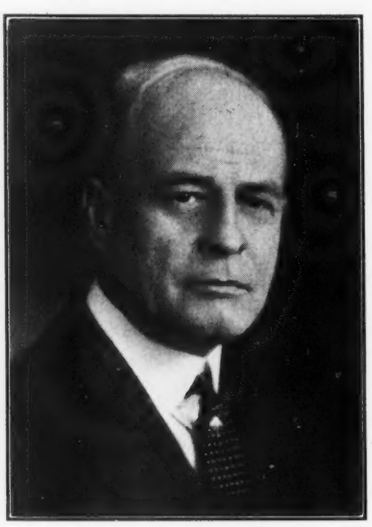
CHARLES EISLER, president of the Eisler Electric Corporation, Newark, N. J., manufacturer of special machinery, sailed for Europe August 30.

Obituaries

Charles Edward Watterson

Charles Edward Watterson, president of the Sheffield Machine & Tool Co., Dayton, Ohio, died suddenly from a heart attack at his home in Dayton on July 24. Mr. Watterson was born in Cleveland in 1871. After having been educated in the Cleveland public schools and at the Western Reserve University, he traveled for many years for one of the companies in the supply business, and located in Dayton in 1906.

In 1914 he visited the Johansson precision gage factory at Eskilstuna, Sweden, and there became interested in precision gaging devices. Two years later he founded the Sheffield Machine & Tool Co. in Dayton and specialized in the manufacture of inspection gages. He developed a number of gaging devices and introduced several refinements in gaging methods.



Charles Edward Watterson

Mr. Watterson's many friends in the industry will deeply regret to learn that he has passed away. His friendly personality will be missed by all who knew him.

F. W. Sinram

F. W. Sinram, president of Gears & Forgings, Inc., Cleveland, Ohio, died in that city August 2. Mr. Sinram was born in Cleveland in 1881, and received his education in the public schools of Cleveland and at the Cleveland Law School, from which he graduated in 1903, being admitted to the Ohio Bar the next year. His business career started with the Van Dorn & Dutton Co., Cleveland, shortly afterward. In 1910 he was made secretary of the company, and in 1918, vice-president. He was also one of the founders of the Van Dorn Electric Tool Co. Upon the organization of Gears & Forgings, Inc., he was made president of that company.

F. W. Sinram

Mr. Sinram was one of the founders of the American Gear Manufacturers' Association, which was organized in 1917. He served continuously as its first president for seven years, and upon retiring from the presidency, was made honorary president for life.

Mr. Sinram was prominent in the gear manufacturing industry and was looked upon as one of the ablest men in that field. He had rare personal qualities and made warm friends with all those with whom he came in contact.

Mr. Sinram is survived by one son, Fred Sinram, a student at the Case School of Applied Science in Cleveland.

NEWS OF THE INDUSTRY

MANNING, MAXWELL & MOORE, INC., 100 E. 42nd St., New York City, announces that the company has acquired the business of the BOX CRANE & HOIST CORPORATION, Philadelphia, Pa. The business will be merged with that of the Shaw Electric Crane Co., Muskegon, Mich., a subsidiary of Manning, Maxwell & Moore. The merged business will operate as the SHAW-BOX CRANE & HOIST Co. The object of the merger is to broaden the line of crane and hoisting equipment produced by the Shaw plant, which builds heavy cranes from 5 to 250 tons, while the newly acquired business specializes in hand cranes, jib cranes, pillar cranes, and hoists from 500 pounds to 20 tons capacity.

NORTON Co., Worcester, Mass., announces that the sales and distribution of the products of the Norton Pike Co. (recently acquired by the Norton Co.) in the United States will be handled through the Behr-Manning Corporation, who is affiliated with the Norton Co. No changes are being made in the Norton Pike Co.'s manufacturing plant, but the domestic sales department and personnel has been merged with that of the Behr-Manning Corporation, with sales headquarters transferred from Pike, N. H., to Troy, N. Y.

PARKETT MACHINERY DIVISION OF THE AUSTIN-HASTINGS CO., INC., 226 Binney St., Kendall Square, Cambridge, Mass., has been organized to specialize in the sale of equipment for machine shops and plate, boiler, pipe, structural, and sheet metal shops. Arthur B. Kettle, formerly associated with Joseph T. Ryerson & Son, Inc., and Frank A. Parker, formerly with the Hill-Clark Co., Boston, and later with the Jones & Lamson Machine Co., Springfield, Vt., will manage the machinery division, which will cover New England.

UNITED CHROMIUM, INC., 51 E. 42nd St., New York City, announces that the United States Circuit Court of Appeals for the Second Circuit has made public an opinion in connection with the patent suit brought by the United Chromium, Inc., against the International Silver Co., under the Fink Patent, U. S. No. 1,581,188. The claims in the suit were held valid. The full text of the decision may be obtained by those interested from United Chromium, Inc., at the address given above.

INTERNATIONAL ENGINEERING SERVICE, Box 1340, Detroit, Mich., designing engineers for machinery and equipment for the automotive and other high-production industries, has established a cooperative export promotion division aimed to give representation and distributing service to small and medium-sized plants that are contemplating to enter the export business. The organization has business connections in most of the important European countries.

BRYANT MACHINERY & ENGINEERING COMPANY, 400 W. Madison St., Chicago, Ill., has appointed Joseph Monahan, 321 Lake Michigan Drive, Grand Rapids, Mich., exclusive agent for western Michigan to represent the lines of machinery distributed by the Bryant organization, including Ohio shapers, planers and horizontal boring, drilling and milling machines, Lehmann lathes, Cleereman upright drills, and Kling friction saws and welding equipment.

FOOTE BROS. GEAR & MACHINE CO., 215 N. Curtis St., Chicago, Ill., has appointed Urquhart Service, 2133 Blake St., Denver, Col., as the company's representative for its line of speed reducers and gears in Colorado and Wyoming. Briggs Schaffner, Winston-Salem, N. C., for several years local representative of the company in the Winston-Salem territory, now covers the entire states of North and South Carolina.

FEDERAL-MOGUL CORPORATION, Detroit, Mich., announces that it has acquired the manufacturing rights for the Wyromatick compensator, a device for the automatic maintenance of bearing adjustments. This compensator was developed by the Wyrick Engineering Co., a research and development corporation.

LENNEY MACHINE & MFG. CO., Warren, Ohio, has granted exclusive sales rights for the United States to Strong, Carlisle & Hammond Co., Cleveland, Ohio, covering the Lenney variable-speed transmission and reduction unit described in May MACHINERY. Foreign sales are being handled directly from the factory.

REVERE COPPER AND BRASS, INCORPORATED, 230 Park Ave., New York City, has opened a sales office in San Francisco, Cal., at 1615 Russ Bldg. R. H. Binns, Jr., Pacific Coast manager in charge of this office, was formerly assistant sales manager of the Rome division of the company.

LELAND-GIFFORD CO., Worcester, Mass., has recently taken over, in its Boston, Worcester, New York, Rochester, and Chicago districts, the sale of the line of die sets and diemakers' supplies made by the Gullberg Sales & Mfg. Co., Inc., Detroit, Mich.

TOOLS & GAGES, INC., Cleveland, Ohio, manufacturer of measuring instruments, gages, and precision tools, announces that the company has removed from its former quarters at 1220 W. 6th St. to a new modern shop at 3106 E. 63rd St., Cleveland, Ohio.

UNIVERSAL FOUNDRY CO., Oshkosh, Wis., has recently added equipment for the production of brass and bronze commercial castings. Heretofore the production has been limited to gray iron, alloy iron, and aluminum castings.

DARDELET THREADLOCK CORPORATION, 120 Broadway, New York City, has licensed the Chandler Products Co. of Cleveland, Ohio, to manufacture and sell bolts, nuts, and screws with the Dardelet self-locking thread.

BABCOCK & WILCOX CO., 85 Liberty St., New York City, announces that after September 1 all purchasing for the company will be concentrated at its Barberton, Ohio, works.

WESTINGHOUSE ELECTRIC & MFG. CO. announces the erection, at the Mansfield, Ohio, plant of the company, of an all-welded warehouse covering 60,000 square feet and costing $150,000.

Coming Events

SEPTEMBER 9—Autumn meeting of the Electric Hoist Manufacturers' Association at Montour Falls, N. Y. E. Donald Tolles, secretary, 165 Broadway, New York City.

OCTOBER 3-7—National Metal Congress, Buffalo, N. Y., sponsored by the American Society for Steel Treating, 7016 Euclid Ave., Cleveland, Ohio, with the cooperation of the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers, the American Welding Society, and the Wire Association.

OCTOBER 3-7—Twenty-first Annual Congress of the National Safety Council, Washington, D. C. Office of the Secretary, Civic Opera Bldg., 20 N. Wacker Drive, Chicago, Ill.

OCTOBER 3-8—Fourteenth annual National Metal Exposition to be held in the 174th Regiment Armory, Buffalo, N. Y. W. H. Eisenman, secretary, American Society for Steel Treating, 7016 Euclid Ave., Cleveland, Ohio.

DECEMBER 5-9—Annual meeting of the American Society of Mechanical Engineers in the Engineering Societies Building, 29 W. 39th St., New York City. Calvin W. Rice, secretary, 29 W. 39th St., New York.

DECEMBER 5-10—Tenth National Exposition of Power and Mechanical Engineering at Grand Central Palace, New York City.

New Publications

MACRAE'S BLUE BOOK. 3334 pages, 9 by 11½ inches. Published by MacRae's Blue Book Co., 18 E. Huron St., Chicago, Ill. Price, $15.

This is the fortieth annual edition of MacRae's well-known guide to manufacturers and distributors in the entire manufacturing industries. It is a guide that will be found useful not only in the purchasing, but also in the sales, production, engineering, and mechanical departments, because of the broad scope of the information that it contains. The main part of the book consists of a classified material and equipment section which lists alphabetically all products used industrially, from abrasives to zonolite, under 44,824 different headings, giving, in each case, the names and addresses of manufacturers or supply houses from which the respective products can be obtained. While this section is alphabetically arranged, and therefore an index in itself, a complete cross-index covering 174 pages and containing tens of thousands of listings is also included.

There are also 254 pages giving, alphabetically, the names and addresses of all manufacturers in the United States whose products are used industrially. Another valuable section is that giving over 30,000 trade names of all industrial products. Another section lists all communities in the United States with 1000 population or over, giving the name of the leading commercial body, the name of its secretary, the leading bank, and all railroads and warehouses. A Canadian section classifies Canadian manufacturers according to the products manufactured, and also gives a complete alphabetical list of Canadian manufacturers in all lines. The work thus constitutes a most complete directory of all industrial enterprises in the United States and Canada, and its many uses will readily suggest themselves to men engaged in industrial work.

BUSINESS VS. FINANCE. By David Cushman Coyle. 44 pages, 5½ by 8½ inches. Published by David Cushman Coyle, 101 Park Ave., New York City. Price, 60 cents.

Of all the voluminous literature that has been published on the business depression and the stabilization of industry we are inclined to believe that this little book is the best. We doubt if any other writer has analyzed more logically the prevailing conditions or pointed out a more common-sense method not only of dealing with the present emergency, but of preventing its recurrence.

The author does not propose to reorganize society on a new economic plane. He accepts all that civilization has developed up to the present time as part of what we must make use of in the future; but he does recognize and clearly point out the defects in the present economic plan that have caused recurring depressions and that underlie our present difficulties. He concedes the fact that it is not possible to "eat your cake and have it too"; but he shows how the cake might be so generally distributed as to provide practically continuous prosperity for industry and for the well-being of the great majority of our population. At the present moment the economic problems are far more important than those involving technical or engineering considerations, and everyone who takes an interest in the future of industry will find it well worth while to read this little book.

YOU, ME, AND BUSINESS. By L. M. Waite. 46 pages, 6 by 9 inches. Published by the Coldfax Publications, South Norwalk, Conn. Price, 60 cents. (In lots of 10, 50 cents each; lots of 25, 45 cents each; lots of 50, 40 cents each; and lots of 100, 25 cents each.)

This book may be called a primer of industrial and business economics. It presents simply and interestingly, and in everyday language, an explanation of the business structure—its purposes, and its defects as they exist today. It is illustrated by simple charts, giving a general idea of the function of business, briefly and concisely. All the important phases of business are dealt with, as well as some of the problems now confronting business, including legislation, tariff, business control, prohibitory business legislation, bad business practices, over-production, industry planning, the business cycle, business depressions, etc. It is a book that will aid in making the working of the business machine more readily understood by men not directly engaged in the financial or business operations of industry.

SPRINGS. 47 pages, 8½ by 11 inches. Published by Wickwire Spencer Steel Co., 41 E. 42nd St., New York City. Sent free on application.

This book contains, in compact form, an unusual collection of practical information pertaining to springs and spring design. A considerable amount of previously unpublished data on both springs and spring wire is made available to engineers and spring users. It is shown how the physical properties of oil-tempered spring wire can be accurately controlled by varying the drawing temperatures. Fundamental spring formulas are given, and a set of helical spring tables, including over 2000 combinations of wire diameter and coil diameter, facilitate spring design without elaborate calculation. The heat-treatment of springs is thoroughly dealt with. This treatise, in combining both a discussion of spring wire and of helical spring design, meets a definite need in industry, since helical spring design requires a better understanding of the physical properties of spring wire than is generally available.

WOOD PATTERNMAKING. By Herbert J. McCaslin. 311 pages, 5 by 7½ inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York City. Price, $2.25.

This is the second edition of a book intended for students who desire to follow the occupation of patternmaking or who wish to familiarize themselves with the principles of the art. The work was designed to serve as a text-book for technical schools. The book does not deal with production methods as applied to patterns, but rather gives those principles of molding and pattern construction that have been established as good practice when a limited number of castings is required.

REVIEW OF WORLD TRADE 1930. 68 pages, 8½ by 11 inches. Compiled by the League of Nations. Published by the World Peace Foundation, 40 Mt. Vernon St., Boston, Mass. Price, 60 cents.

INTERNATIONAL TRADE STATISTICS 1930 (Including summary figures for 1931). 369 pages, 8½ by 11 inches. Compiled by the League of Nations. Published by the World Peace Foundation, 40 Mt. Vernon St., Boston, Mass. Price, $2.50.

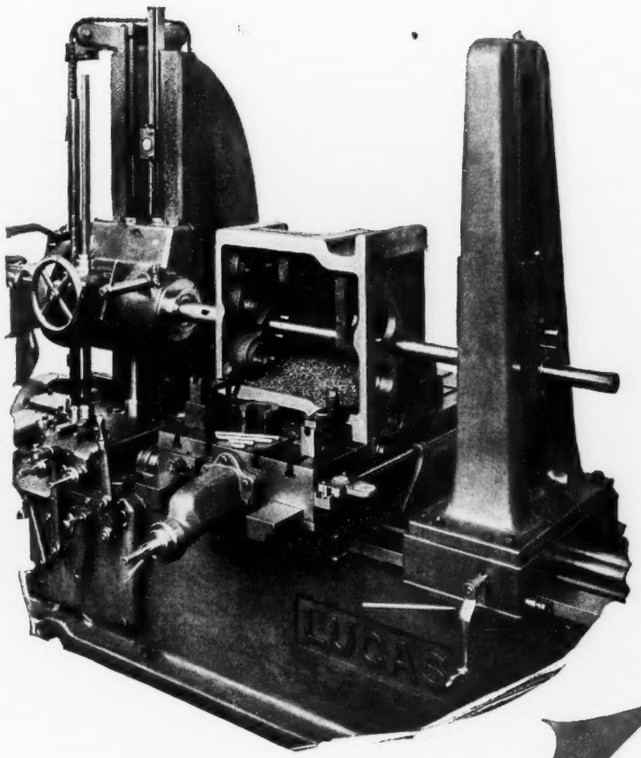
STATISTICAL YEARBOOK OF THE LEAGUE OF NATIONS 1931-32. 342 pages, 7½ by 9½ inches. Compiled by the League of Nations. Published by the World Peace Foundation, 40 Mt. Vernon St., Boston, Mass. Price, $3.

BALANCES OF PAYMENTS 1930. An Analysis of Capital Movements. 183 pages, 8 by 10½ inches. Compiled by the League of Nations. Published by the World Peace Foundation, 40 Mt. Vernon St., Boston, Mass. Price, $1.50.

These statistical volumes contain a mass of information relating to world trade and world financial conditions. Besides a general description of foreign trade conditions, they give detailed figures showing increases and decreases in exports and imports and tracing the movements in prices of raw and manufactured products, with complete trade statistics for sixty-four countries. Of particular interest is the study of changes in direction of international trade, indicating the decline of some foreign markets for American goods, with the opening of new ones.

PRODUCTS OF MANUFACTURING INDUSTRIES —1929. 169 pages, 6 by 9 inches. Published by the Bureau of the Census, Washington, D. C. Sold by the U. S. Government Printing Office, Washington. Price, 15 cents.

EMPLOYES' SUGGESTION SYSTEMS. 24 pages, 8 by 11 inches. Published by the Metropolitan Life Insurance Co., 1 Madison Ave., New York City.



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Dial Indicator Indexing Device

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